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The Citrus Industry of MEXICO

FOREIGN AGRICULTURAL SERVICE
U.S. DEPARTMENT OF AGRICULTURE

TERMINOLOGY[1]

The following are the Mexican terms used for citrus fruits:

Mexican	English
Lima dulce	Sweet lemon
Lima agria	Sour lemon
Limón comúnagrio	West Indian lime or Mexican sour lime
Limón real	Persian lime
Cidra	Citron
Mandarina	Tangerine
Naranja	Orange
Toronja (Federal District and Veracruz)	Grapefruit
Pomelo (Nuevo Laredo and Tamaulipas)	....do.......

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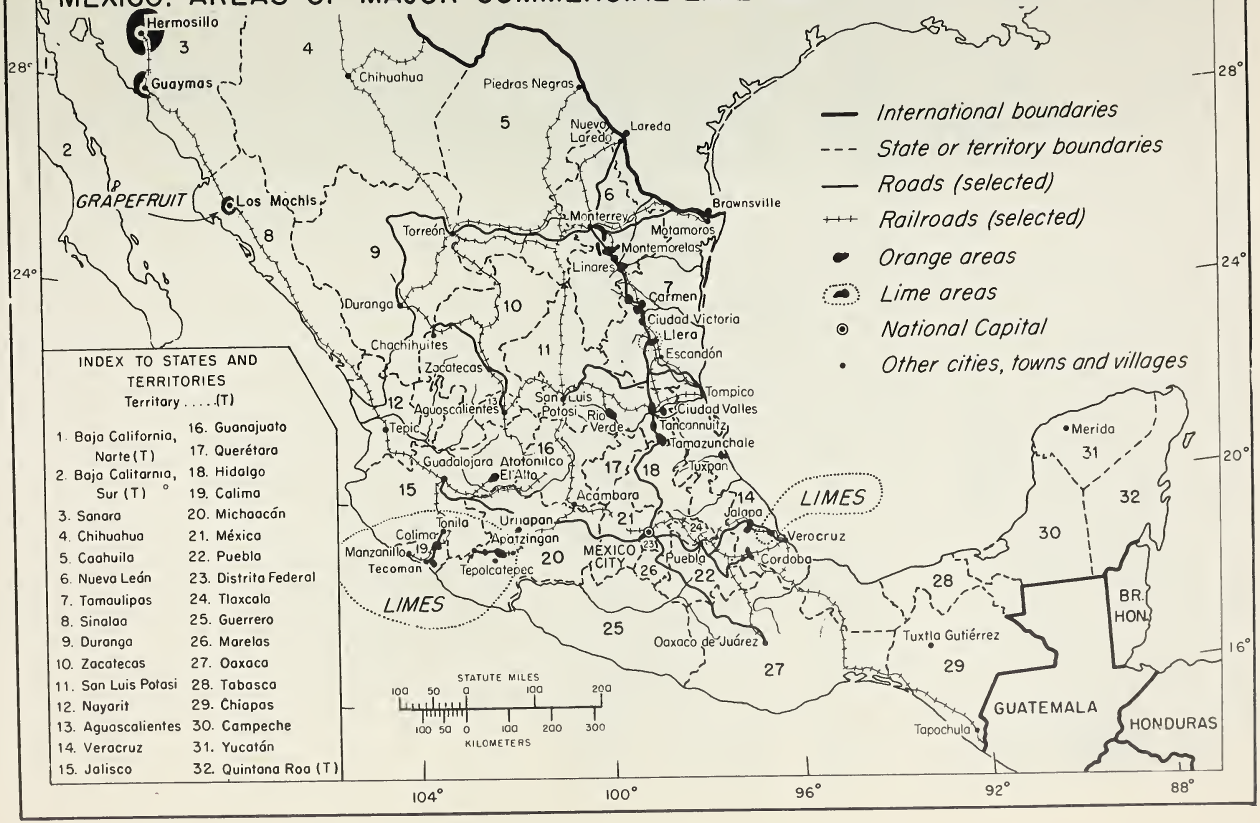
[1] Roberto Solis, economist, Office of U.S. Agricultural Attaché, American Embassy, Mexico City.

MEXICO: AREAS OF MAJOR COMMERCIAL LIME AND ORANGE PRODUCTION



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FOREWORD

Mexico has the world's largest production of limes and an orange industry as large as that of Italy and half the size of Spain's. While most of Mexico's orange production is not of export grade, the quantity of good-quality oranges is increasing. Mexico's orange processing industry is also growing and Mexican juice now supplements U. S. frozen concentrate production. Advances in the Mexican industry are changing its competitive potential.

This publication brings up to date and supplements "The Fruit Industry of Mexico," by F. A. Motz and Lester D. Mallory, published in 1944, and "Changes in Mexico's Citrus Industry," published in 1953 as Foreign Agriculture Report No. 70.

DM Rubel

D. M. Rubel, Director
Fruit and Vegetable Division

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THE CITRUS INDUSTRY OF MEXICO

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SUMMARY AND CONCLUSIONS

The past 10 years have been a decade of rapid change in Mexico. Water resources and electric power have been developed, railroads have been improved and the national highway system extended. All this has had an influence on the growth of the country's citrus industry.

In 1961, orange plantings were an estimated 200,000 acres compared with 164,000 acres in 1951. Lime plantings were 31,000 acres, 1,000 acres larger than 1951. Grapefruit plantings were estimated at 3,000 acres, and tangerines at 14,000 acres. Lime plantings have declined in Apatzingan and increased in other areas. By 1971, orange plantings could reach 225,000 acres; limes, 50,000 acres; grapefruit, 4,000 acres; and tangerines, 20,000 acres.

Orange production has gradually increased, reaching about 20 million boxes in 1961. Lime production has been fairly constant at about 2 million boxes per year, and grapefruit production probably totals 300,000 boxes per year. Also, the quality of the fruit produced has improved. By 1971, total orange and tangerine production may reach 23 million boxes per year; grapefruit, 350,000 boxes; and limes about 2½ million boxes.

The eastern Mexican States of Nuevo Leon and Tamaulipas have the fastest growing citrus industries and are expected to supply most of Mexico's export-quality fruit upon recovery from the freeze damage of 1962.

Mexico's domestic market has also changed and, while most fruit is still delivered in bulk, there is a premium market for sized and graded "fancy" fruit. Chain stores are hastening the development of orderly citrus marketing. The growing domestic market is likely to consume most citrus supplies.

In the past decade, Mexico's total exports of oranges have averaged 300,000 boxes per year except in periods of world shortage. Total orange exports will probably range from 500,000 to a million boxes a year after 1965 when production in Nuevo Leon is restored. Mexico could supply as much as 3 million boxes of export-grade oranges in years of world shortage. Grapefruit exports will remain small and should not exceed 50,000 boxes in any year. In the immediate future, Mexican fresh lime exports will probably average about 35,000 76-pound boxes per year.

Canadian imports of Mexican oranges have been less than 100,000 boxes per year since 1955 except in 1958 and 1960 when shortages resulted in high prices in the United States. Western Europe's imports of Mexican oranges were heaviest in 1956 and 1957 following the freeze in Spain. As Mediterranean supplies returned to normal, imports from Mexico decreased.

A few citrus trees growing among field crops is a common sight in Mexico wherever citrus can survive. Such plantings provide a major share of Mexico's citrus, all of it for the local markets.

U.S. citrus trade with Mexico has been a two-way street and, in the period 1950 to 1960, U.S. imports of oranges from Mexico totaled 1.4 million boxes and U.S. exports to Mexico, 1.3 million boxes. Mexican exports to the United States have been in the winter season, competing with the U.S. Gulf Coast producing areas. U.S. sales to Mexico have been in the summer--usually to border towns near California. After 1965, U.S. imports of Mexican oranges will increase in years of U.S. shortages and U.S. sales to Mexico may decrease as Mexican Pacific Coast orange production grows. However, U.S. sales to Mexico may increase through 1964 to replace production lost in Nuevo Leon.

In the past decade, U.S. imports of limes from Mexico have averaged about 50,000 boxes per year, while U.S. exports of lemons to Mexico have increased from 6,000 boxes in 1950 to over 50,000 boxes in 1960.

Comparison of the prices obtained for Mexican oranges in Western Europe indicate that when competing U.S. and Mediterranean fruit is of sound quality the Mexican "Lisa" orange has been substantially discounted, primarily because of its erratic quality. The Mexican Valencia orange will be the most competitive variety from Mexico in U.S., Canadian, or Western European markets.

One aspect of the industry that has changed little is Mexico's rural wage rate; it ranges from 56 cents to $1.20 per day, much as it did 10 years ago.

Cash cultural costs are about the same too. Total 1961 cash cultural costs of operating a mixed-planted irrigated grove at Coatepec, Veracruz, were estimated to range from $10.00 to $20.00

per acre. Unirrigated groves in Nuevo Leon could be operated for an estimated cash cost of about $33.00 per acre. In eastern Mexico, the cash cost of producing export-quality oranges has been estimated to range from $45.00 to $55.00 per acre per year. This would represent the very best care, since in 1961 few growers were spending as much as $50.00 per acre per year to care for citrus.

The cash cultural cost of producing oranges in 1961 was estimated at 20 to 37 cents per 70-pound box in Nuevo Leon, 16 to 17 cents in Veracruz, and 13 to 25 cents in the Rio Verde Valley.

At 1960-61 costs and prices, Mexican orange growers were having good returns--$75.00 to $195.00 per acre net in Nuevo Leon irrigated groves and $38.00 to $81.00 per acre net on mixed-planted seedling shade-grown oranges in Veracruz.

In all districts the cost of domestic marketing was greater than the cost of production. Picking, intransit fees and taxes, and cartage to Mexico City were estimated at 58 cents per 70-pound box from Nuevo Leon, 30 to 40 cents from Veracruz, and about 42 cents from the Rio Verde Valley.

Export costs are much higher. The Nuevo Leon cost of packing a 1-2/5 bushel box of oranges and delivering it to the U. S. border was estimated at $1.45, including 57 cents for the box, 15 cents for packing, 32 cents cartage to the border, and 41 cents border fees. With production costs added, this cost (break-even) would be $2.75. Mexican exporters in 1961 could pay Nuevo Leon growers $2.00 per 70-pound box for Valencia oranges and deliver the fruit export-packed to the U.S. border, U.S. duty paid, for $5.00 per 1-2/5 bushel box and make a profit of nearly 70 cents per box.

Oranges sold abroad must bring a price of at least $1.75 per box more than in the domestic market before exports are attractive.

In the past 10 years Mexico has doubled its processing capacity. In 1961, processors used about 1.5 million boxes of oranges--5 to 7 percent of total production. Products include hot-pack and frozen orange juice concentrate. Exports of processed products have also grown.

By 1960, exports had increased to 583,000 gallons of orange juice concentrate, mostly frozen, 22,000 gallons of lime juice, 1,000 pounds of orange oil, and 143,000 pounds of lime oil.

In the future, Mexico may be expected to become a much more important source of citrus products and be more competitive with U. S. orange juice in Canada and Western Europe, but this competition from Mexican juices will be postponed by the 1962 freeze in Nuevo Leon. In the immediate future, Mexico will be pressed to supply its own juice needs and it may be 1965-66 before orange juice exports can again reach 1960 levels.

Export opportunities to the United States are always limited since all Mexican producing areas have fruitflies. Processing fruitfly-infested oranges or grapefruit will result in defects in some juice lots, such as maggot eggs and insect particles, which will prevent imports into the United States.

FRESH FRUIT

Acreage

Commercial acreage of every citrus variety in Mexico has increased in the past 10 years. In 1961, orange plantings were estimated at 200,000 acres compared with 164,000 acres in 1951, and lime plantings at 31,000 acres compared with 30,000 in 1951. Grapefruit and tangerine plantings have increased also, but no information is available on the size of the increase. (These estimates are based on trade information and field evaluation of the major commercial producing areas. In estimating acreage, mixed plantings are expressed in solid-planting equivalents. These estimates may be compared with official 1958 data in tables 21 and 22.)

In the important Nuevo Leon district, orange plantings in irrigated areas have been partly offset by the decline in tree numbers in unirrigated areas. In Veracruz, new coastal plantings have about equaled the removal of trees near Fortin. Orange acreage in the State of Jalisco has changed little, while plantings in San Luis Potosi and Tamaulipas have increased.

Lime acreage is estimated to have increased slightly in spite of the decline in Veracruz and the Apatzingan district in Michoacan.

Tangerine acreage is increasing also, and so are grapefruit plantings, but this increase is small.

As soon as the northeastern groves recover from freeze damage, Mexico's citrus plantings are expected to continue

TABLE 1.--Acreage in citrus, Mexico, 1951 and 1961

Variety and state	Planted area			
	1951[1]		1961[2]	
	1,000 trees	*1,000 acres*[3]	*1,000 trees*	*1,000 acres*[3]
Oranges:				
Nuevo Leon	4,783	77	6,000	100
San Luis Potosi	760	13	2,000	20
Tamaulipas	674	11	1,000	13
Veracruz	[4] 4,000	[4] 34	3,000	40
Jalisco	500	3	500	3
Sonora	--	--	250	3
Sinaloa	--	--	50	1
Total	10,717	138	12,800	180
Other	1,607	26	1,700	20
Total	12,324	164	14,500	200
Limes:				
Colima	300	3	1,400	14
Michoacan	900	15	400	6
Veracruz	150	2	125	2
Tamaulipas	150	2	275	3
Total	1,500	22	2,200	25
Other	500	8	500	6
Total	2,000	30	2,700	31
Grapefruit:				
Total Mexico	--	--	--	3
Tangerines:				
Total Mexico	--	--	--	14

[1] Foreign Agriculture Report No. 70 "Changes in Mexico's Citrus Industry," 1953.
[2] Estimated.
[3] Estimated commercial mixed plantings in Veracruz expressed as solid-planting equivalents.
[4] Revised.

Official sources.

expanding. Oranges, particularly the Valencia variety, should have the fastest increase, followed by tangerines. Small increases in lime and sweet lemon acreages may be expected, but these will probably follow Mexican population trends. Grapefruit will be slow to expand because of the small domestic market.

By 1971, total acreage could reach 225,000 acres of oranges, 50,000 acres of limes, 4,000 acres of grapefruit, and 20,000 acres of tangerines.

Production

In the past 10 years, total citrus production in Mexico has tended to increase, although the rate has not been rapid. Orange production has increased from an average of about 17 million boxes to about 20 million boxes per year; lime production has remained fairly constant, averaging about 2 million boxes per year, and grapefruit production now totals slightly less than 300,000 boxes per year.

As the quantity of citrus has increased, its quality has improved. In 1950, about 3 million boxes of oranges in Mexico were of export variety and grade. In 1961, Mexico was probably producing 4 million boxes of oranges of export variety and grade. With the decline of the lime-producing area at Apatzingan in the State of Michoacan, production of limes of export quality has declined--from about 700,000 boxes in 1951 to a probable 200,000 boxes in 1961. This trend will probably be reversed as the new lime groves at Colima come in to production. About a third (100,000 boxes) of the grapefruit produced is of export quality. Tangerine production is not shown separately but total production in 1961 probably ranged from $1\frac{1}{2}$ million to 2 million boxes; at least a half million boxes are of export variety and grade.

This trend toward quality production will probably continue. It will be stimulated more by the demands of the domestic market than by exports. Practically all of the export-quality oranges and tangerines will be produced in the State of Nuevo Leon, supplemented by small quantities from the States of San Luis Potosi and

TABLE 2.--Citrus production and exports, by variety, Mexico, 1950-60

Year	Production[1]			Total exports[2]		
	Oranges	Grapefruit	Limes	Oranges	Grapefruit	Limes
	1,000 boxes	*1,000 boxes*	*1,000 boxes*	*1,000 boxes*	*1,000 boxes*	*1,000 boxes*
1950	17,478	--	1,932	904	--	93
1951	15,818	--	1,874	228	--	85
1952	16,814	--	2,044	269	--	73
1953	17,545	--	2,142	206	--	147
1954	18,838	--	2,228	197	--	70
1955	19,684	--	2,163	458	--	47
1956	19,688	138	2,227	772	--	64
1957	20,671	198	2,289	1,537	--	36
1958	20,842	220	2,393	1,631	1	31
1959	20,818	287	2,425	857	0	27
1960[3]	19,526	276	2,067	748	0	23

[1] In the year of the bloom, oranges in 70-lb. boxes; grapefruit in 80-lb. boxes; limes in 76-lb. boxes.
[2] Calendar years.
[3] Preliminary.

Official data.

Tamaulipas. Official Mexican production data may be considered as a fairly accurate appraisal of total citrus supplies in Mexico.

The 1962 freeze in Nuevo Leon will retard, but not change the direction of, Mexican citrus development.

In the future, the majority of the export-quality limes will be from the State of Colima.

By 1971, orange production may reach 23 million boxes a year, including about 2-1/2 million boxes of tangerines, grapefruit production may reach 350,000 boxes, and a lime crop of about 2-1/2 million boxes is possible.

Yields

In the State of Nuevo Leon the highest orange yields are obtained from Valencia's planted in irrigated groves where the average annual yield, of trees over 15 years of age, is estimated to range from 120 to 250 70-pound boxes per acre. A few of the best-cared-for groves have higher yields. There is a large acreage of unirrigated groves where production depends on seasonal rainfall. In these groves the yield of Valencia oranges is estimated to range from about 25 to 75 boxes. In years of drought, little or no production is realized, and when rainfall is adequate the average yields of these poorly cared for groves is not likely to exceed 75 boxes per acre (table 15).

Yields also vary by variety. The Washington Navel orange in Nuevo Leon has average yields very much lower than those of "Lisas" or Valencia, and full-bearing trees in irrigated orchards which are over 15 years of age are said to average 80 to 100 70-pound boxes of fruit per acre per year. In contrast, irrigated groves of tangerines have very much higher yields and full-bearing groves average 200 to 250 70-pound boxes per acre.

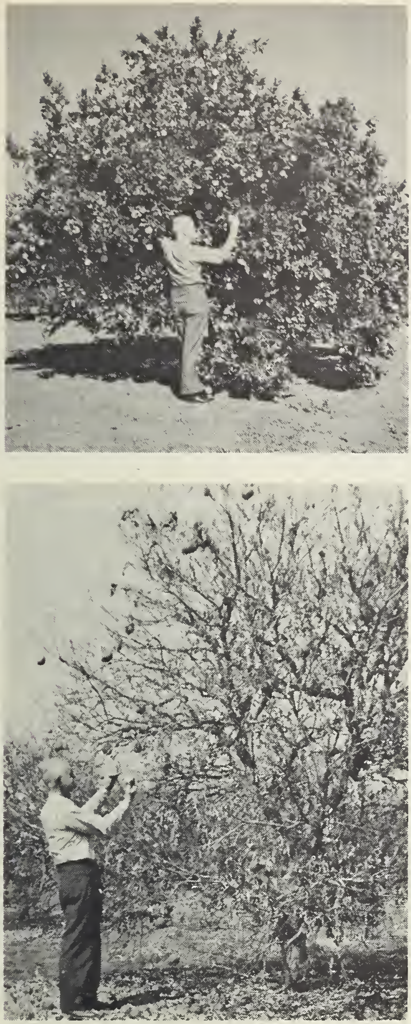
The State of Veracruz has a different yield pattern. In this State most of the citrus production is seedling oranges, shade-grown with coffee. In such groves the yields are low and said to average 60 to 125 boxes per acre per year. In the coastal producing areas north of the town of Veracruz, unshaded orange groves are said to have much higher yields, averaging 125 to 250 boxes of fruit per acre.

In the State of San Luis Potosi the yield of mature orange groves in the Rio Verde Valley is estimated to range from 100 to 200 boxes per acre. Tangerine yields in this area are also good and groves were seen which were picking over 400 boxes per acre. The warm humid coastal areas in this State near Valles have lower average yields than the irrigated Rio Verde Valley.

Producing Areas

Nuevo Leon

Nuevo Leon is Mexico's most important orange producing district for juice, domestic marketing, and exports. Nearly all of Mexico's export-quality oranges are produced here. The 20-year expansion has been interrupted only by freeze damage in 1951 and 1962.



Fine orange tree damaged by 1962 freeze in Nuevo Leon contrasts sharply with one photographed in the area just a year earlier.

This industry grew from about 2 million trees in 1940 to 4.8 million (77,000 acres) in 1951; some sources estimated total orange plantings as high as 10 million trees in 1961. Field observations indicated that large areas of unirrigated groves are not commercial; therefore, the 1961 commercial orange plantings are estimated as 6 million trees planted on 100,000 acres.

The January 1962 freeze destroyed or heavily damaged an estimated 2 million nonproducing orchard-planted trees and destroyed 80 percent of the nursery stock. In the next decade, many young groves will have to be replaced. While the rate of growth has been retarded, new plantings will be made, and Nuevo Leon could have 110,000 acres of commercial orange plantings by 1971, but for the 1962 freeze the planted area would have expanded more rapidly.

Varieties grown here are reported as 9.5 percent Washington Navel; 25.4 percent "Lisas" (a group of early and midseason types including Hamlin, Pineapple, Parson Brown, San Miguel, and others); 60 percent Valencias; 5 percent tangerines, and 0.1 percent grapefruit.[1]

Most production is still the "Lisa" group, but new plantings have been largely Valencia oranges. When young groves come into production, the Valencia will be the most important variety and Nuevo Leon will become an important late-orange producing area.

The season here is much the same as in the Gulf Coast citrus areas of the United States. The Navel and "Lisa" oranges are harvested from November to March, and Valencias from March through June and a few as late as August.

The older "Lisa" groves are mixed plantings of four varieties or more and, since each has a different maturity, there is no uniformity to much of Nuevo Leon's orange production. This is complicated further by production from unirrigated groves which produce out-of-season fruit as each drought-breaking rain results in a bloom. The production from irrigated Valencia groves, capable of growing oranges of uniform quality, is still a small percentage of the total harvest but it will increase as new plantings come into production.

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[1] Estimates of 1961 plantings and percentages of varieties grown are data developed by Engineer Salvador Sanchez Colin.

While most of the young groves are plantings of single varieties, there is still some planting of mixed "Lisa" groves.

The condition of citrus production varies greatly between citrus districts.

Caderyta-Allende.--About a fourth of the citrus plantings in Nuevo Leon are to be found on the road between Caderyta and Allende. When this area was observed in 1953, it was estimated to contain about 5,600 acres of citrus, of which about 4,800 acres could be considered as commercial quality. In the following 8 years, the condition of the groves deteriorated, and in 1961 not over 1,500 acres could be considered to be in reasonable condition.

Field observations early in 1961 indicated that not over 10 percent of the citrus planted was under irrigation. Only a small percentage of the unirrigated groves were in good commercial condition. Many of the groves were semi-cared-for and about half seemed to be abandoned. The trees had a great deal of deadwood, there were many dead trees in groves, and some have died out and been removed. Nearly all of the groves in this area indicated general nitrogen deficiency by the yellow coloring of the leaves.

There are some new orange plantings, but the number of trees dying out far exceeds new plantings. The general trend, therefore, is for a reduction of citrus acreage in this area.

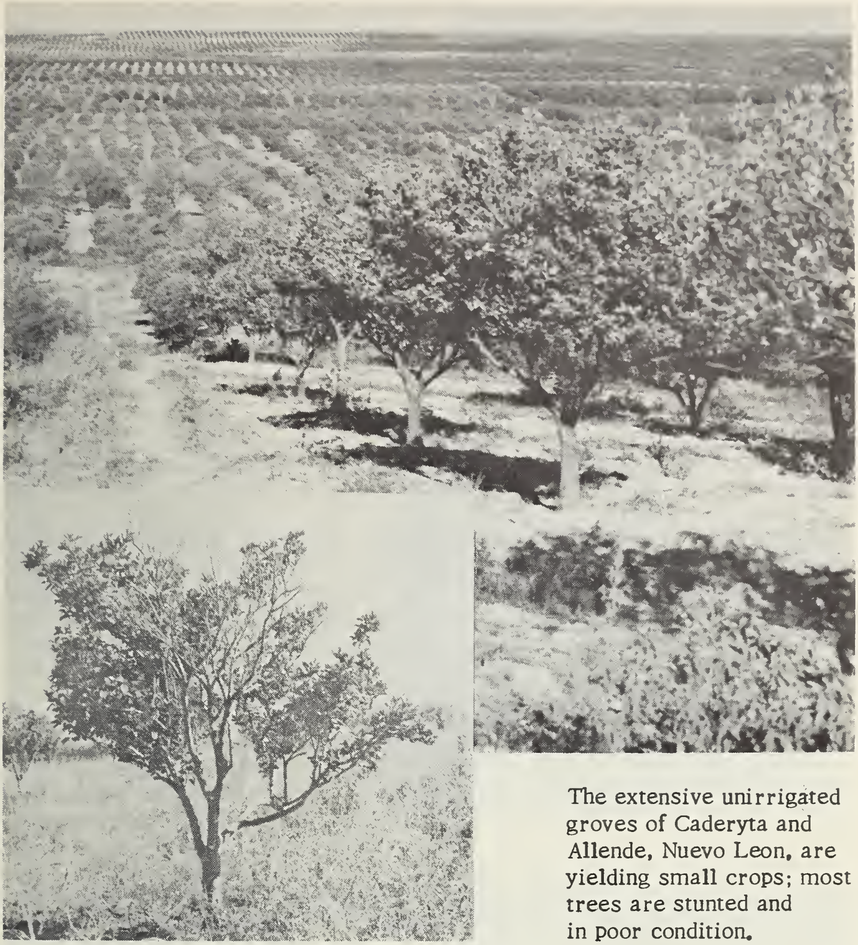
Very few of the groves observed seemed to have any pest control program. Since nearly all of this area is unirrigated, blooms occur at odd times throughout the year, resulting in many sets of fruit and many different maturities at time of harvest. Due to this uneveness in the quality of the fruit, it is of doubtful value for exports. It is suitable only for sale in the Mexican market. These are the usual conditions in this district.

Later in 1961, heavy rains from the Hurricane Carla resulted in a good set of fruit which revived interest in the district. In February 1962, it was observed that most groves had been cultivated and plantings extended.

The January 1962 freeze destroyed all fruit, defoliated the entire district, and killed all recent plantings and low-lying bearing groves. A small percentage--5 or 10 percent--of the district suffered only defoliation and will rapidly return to production, but a considerable part of the groves were killed to framework limbs.

Since these are largely unirrigated groves, the extent of the damage and rate of recovery will depend on the amount of rainfall early in 1962.

The outlook for this district is not favorable, and those groves which are commercial may be expected to also decline in importance in the next 10 to 15 years. In the groves observed, there was a heavy incidence of the virus psorosis. This virus will limit production and ultimately destroy trees.



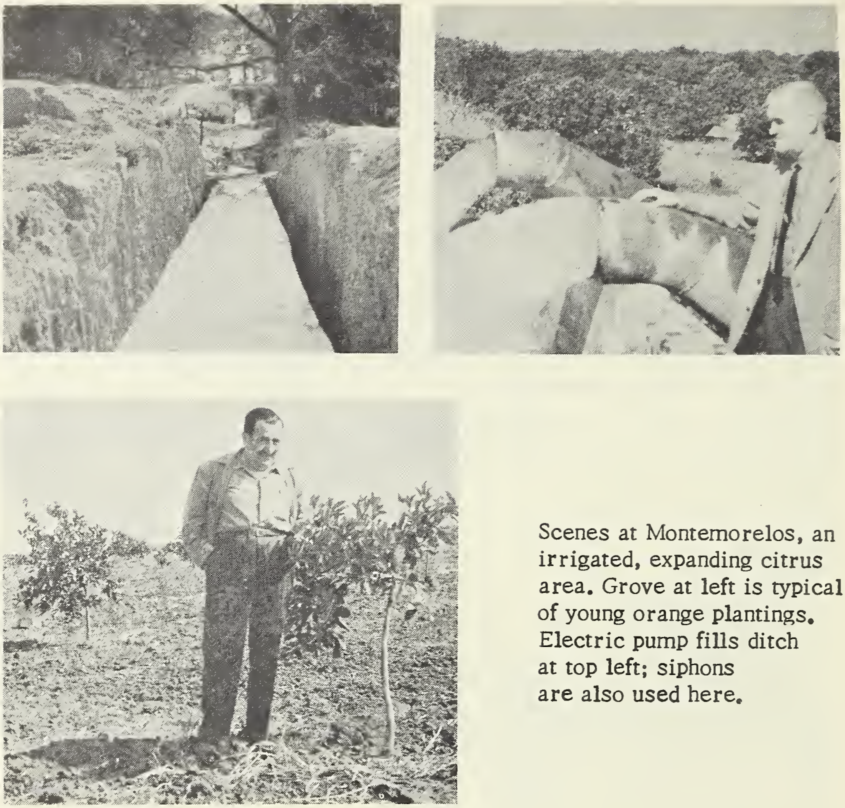
The extensive unirrigated groves of Caderyta and Allende, Nuevo Leon, are yielding small crops; most trees are stunted and in poor condition.

Montemorelos-General Terán-Linares.--The major expansion of plantings in the past 10 years has been in the districts near the towns of Montemorelos, General Terán, and Linares.

Citrus plantings here are on the plain east of the mountains. Most groves are on fairly level, deep loam soil, and about 40 percent are irrigated and all are subject to occasional frost damage.

Field observations indicate that plantings have been expanded by at least 2 million trees in the past 10 years. Large nurseries seen in 1961 indicated that growers intended to continue to expand citrus acreage. Many of the new orchards were killed or seriously damaged in the freeze of January 1962. The tempo of expansion will probably be resumed about 1964 when nursery trees are again available.

The potential of southern Nuevo Leon citrus districts may be evaluated from the cultural conditions observed in 1961.



Scenes at Montemorelos, an irrigated, expanding citrus area. Grove at left is typical of young orange plantings. Electric pump fills ditch at top left; siphons are also used here.

The best cultural care in Mexico is practiced here. Trees are well spaced, about 75 to the acre. Nursery trees are well grown, and the good color of mature trees indicates that fertilization is fairly adequate.

The best-cared-for bearing groves are fertilized twice a year--in the spring and fall with chemical fertilizers. Total application is usually 1/2 to 1 pound of nitrogen per tree per year. Mixed fertilizer, such as 5-25-20, and manure are also used by some growers. Many groves need no fertilizer because of the rich soil.

Bearing groves seen had good crops of fruit and the young trees were growing well.

Many extensive new groves were seen; reportedly new plantings are mostly in Valencia oranges. As more late fruit is produced, the control of the Mexican fly may increasingly become a problem.

Growers here know and trade with U.S. citrus shippers. They are aware of U.S. cultural practices, and they are the most progressive orange growers in Mexico, who know how to produce export-grade fruit.

As young Valencia groves come into production, the Mexican orange season will be extended and as the Mexican market becomes more discriminating Nuevo Leon's good quality, clean, naturally colored fruit will offer increased competition to other Mexican producing areas, and also a larger supply of export-grade fruit.

Pests and diseases.--Nuevo Leon has variations in climate which are favorable environment for a wide range of citrus pests. At times, serious droughts occur, and low humidity is favorable to one kind of pest, whereas at other times rainy weather is favorable to other insects and pests. For example, this area is subject to heavy damage at times by both the California red scale and the Florida red scale. Purple scale and chaff scale are also important pests in some years.

The rust mite is the most serious continuing pest problem and at times is more damaging to commercial fruits than the Florida red scale. Red spider also damages fruit in some areas, and the fungus melanose is a serious problem in times of extended wet weather.

In spring when there is a heavy flush of new growth, aphids damage some groves, but little effort is expended on control.

The Mexican blackfly is a major pest problem in all citrus areas. In the State of Nuevo Leon, it is controlled by oil sprays and malathion. South of the State of Nuevo Leon the blackfly is controlled by biological means.

At times the Mexican fruitfly, another serious pest in most citrus producing areas, is found in Nuevo Leon. The intensity of infestation varies from district to district. One of the areas of most intense infestation is at Llera, and other areas of serious infestation are Santa Engracia and El Carmen. Little attention is given this insect pest, but control can be obtained through the use of malathion bait sprays.

Citrus in the Nuevo Leon area is under the constant surveillance of U.S. Department of Agriculture Plant Pest Control crews. They eradicate the Mexican blackfly and watch for infestations of the Mexican fruitfly.

The most common pest control operation is the one against the rust mite, which uses sulfur dust and sprays. More intensive

Gummosis, on the orange tree above, is Mexico's major citrus disease. The virus, psorosis (left), is prevalent in Nuevo Leon's citrus groves.

spraying is done to control scale pests, but very few growers use oil sprays each year. The common practice is to oil-spray about every other year. Some growers follow the practice of spot spraying scale infestations with oil sprays. Growers who follow this practice explain that by spot spraying they do not kill predatory insects and thereby hope to obtain some biological control.

Citrus growers own both conventional and speed sprayers for their pest control application. This grower-owned equipment is supplemented by government spray equipment, primarily used for control of the blackfly, which can at times be obtained for use in pest control at a nominal charge.

South of Mexico, in adjacent countries, are infestations of the Mediterranean fruitfly. There is the danger that this serious pest might invade Mexican fruit-producing areas where commercial and wild hosts might turn this into Mexico's major citrus pest. Should a Mediterranean fruitfly infestation occur, Mexico's control problems would be very much greater, as would the quarantine problem of the United States.[2]

The citrus area of Nuevo Leon has the primary disease problems of a relatively new citrus industry. The major disease is gummosis, caused by the phytophthora fungus. To combat this disease, sour orange rootstock is used exclusively. Little damage from gummosis was observed in the orchards visited in 1961. Virus diseases will cause the greatest damage to Mexican citrus groves in the long run. Outbreaks of the virus psorosis were observed in groves over 15 years of age. The deadwood and dying limbs in many trees attest to the fact that this virus is beginning to limit production. Since the budwood used to propagate the new trees in plantings now being made has not come from virus-free budwood, it may be anticipated that this virus will continue to be a long-range disease problem.

Nuevo Leon's sweet orange, tangerine, and grapefruit groves are all on sour orange rootstock. This makes them susceptible to the tree-killing virus tristeza. This virus has not been identified in Mexico and it is unknown whether there are vectors present which could carry this disease. Should this virus strike, it could be the most devastating disease problem of all.

Grapefruit tree in well-cared-for irrigated grove in Nuevo Leon.

Tangerines, grapefruit.--There has been a growing interest in tangerine production in this Mexican citrus area. This fruit is very popular on the Mexican market and trade sources report that prices of 800 pesos ($58.00) per short ton have been paid for tangerines at the same time that 400 pesos ($29.00) per ton

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[2] See Appendix.

($1.00 per 70-pound box) was being paid for oranges. The most profitable orange crop has been the late Valencia variety. In May and June, this variety has sold on the domestic market for as much as 1,200 pesos per metric ton ($3.00 per 70-pound box).

There has also been a growing interest in both red and white grapefruit. The domestic Mexican market is slowly increasing its consumption of this variety.

The growing demand for citrus in Mexico has limited the interest in exports. Recently the domestic market has returned better prices than export sales.

Marketing.--Most of the oranges and tangerines produced in the northern part of Nuevo Leon are sold in the domestic market. Oranges are pull picked from the tree and sent to market unwashed and ungraded by bulk transport in motor trucks. The early varieties of oranges and tangerines produced in Nuevo Leon are marketed mostly in the eastern and northern Mexican States. Very little of this early fruit is sent to the market in Mexico City because of competition from fruit produced in the State of Veracruz. About half of the late Valencia oranges produced at Montemorelos are sold in Mexico City. Oranges and tangerines for Mexico City are sent to market by motor trucks, which are usually privately owned and make a business of this internal transport. The freight for oranges from Montemorelos to Mexico City in 1961 is reported to be 190 pesos per metric ton ($0.48 per 70-pound box). The trucks hauling fruit from Nuevo Leon to Mexico City usually pick up other freight for the return trip. The return journey to Nuevo Leon may be made via Veracruz and Tampico to pick up bananas, mangoes, and papayas for sale in the northern part of Mexico.

These bulk sales to interior markets are made in several ways. Some of the buyers from the Mexican market come to Montemorelos to make their own purchases and thus arrange for their own transport. Some fruit is sold through a representative of the Nuevo Leon shipper.

Also, shippers who pack fruit for export or sell in the domestic market attain their supplies in many ways. They may estimate and buy fruit for a flat price for the entire crop. Or they may buy the fruit per tree. Sometimes, they buy the fruit by weight and by count. The most common methods of purchase are by weight and on the tree.

Depending on the method of purchase, the buyer may pick the fruit or the grower may pick the fruit. Fruit which is purchased on the tree or by estimate of the entire crop is picked by the purchaser. Fruit which is sold by count is usually picked by the grower.

The packing used for export fruit depends upon the market to be supplied. Oranges destined for Europe are full-wrap packed usually 1-2/5-bushel boxes. The wraps used for export to Europe are treated with diphenyl. Most of the fruit sold to the United States and Canada is not wrapped; however, some exporters were observed wrapping the top layer of oranges to be sold in Canada. Exporters estimate that about half of exports are in full size 1-2/5-bushel boxes and about half are in the one-half wire-bound Bruce box.

In preparing oranges and tangerines for export the fruit is washed and waxed with wax preparations used in the U. S. industry, and the fruit is sized and graded. All of the unwrapped packs are hand-placed in the box.

Early-season fruit, Washington Navels, and "Lisas," may be colored with citrus red No. 2. Tangerines are said never to be colored. Oranges observed in January 1961 were of good color and tangerines were of high color.

The citrus packing plants observed were fairly well-equipped, reasonably efficient installations. Considering the usually small volume of fruit handled in export, they are well equipped. Each plant has facilities for washing, waxing, grading, and sizing of fruit. The wooden boxes used in export are all made at the plant from shook which is said to be supplied by the State of Durango. The box shook seen was of excellent quality.

While the full 1-2/5-bushel box and the half wire-bound Bruce box are used for the export of oranges, tangerines are exported in small crates which have slats permitting ventilation. The construction of the boxes and the labeling were excellent. Some of the fruit exported is stamped with the brand name of either the buyer or the shipper.

Orange harvest in Nuevo Leon. Left, oxen still haul the fruit from some groves. Above right, fruit is piled up in grove and then counted.

Mexican oranges from the State of Nuevo Leon tend to be of large size. The early Navel variety produces sizes predominately 70, 80, and 90 fruit per box. The early "Lisa" oranges are smaller, and the largest quantity of fruit is in counts of 216, 256, and 288 fruit per box. The late Valencia oranges are slightly larger and the most important counts are 176, 200, and 216 fruit per box.

TABLE 3.--Oranges and tangerines: Representative packout, Nuevo Leon, 1959-60

Size (fruits per box)	December		January	May
	Tangerines (in 1/2 standard, 4/5-bu. box)	Navels (in 7/10-bu. Bruce wire-bound box)	Lisas (in 7/10-bu. Bruce wire-bound box)	Valencias (in 7/10-bu. Bruce wire-bound box)
	Percent	*Percent*	*Percent*	*Percent*
27	--	5	--	--
36	--	14	--	--
40	--	11	--	--
50	--	33	--	--
64	--	22	--	--
80	--	8	--	--
100	10	7	--	--
120	30	--	--	--
150	30	--	8	--
176	28	--	12	14
200	--	--	9	16
210	2	--	--	--
216	--	--	22	30
252	--	--	26	20
288	--	--	12	15
324	--	--	11	5

Source: The trade.

Citrus for export to the United States is all fumigated in Mexico under supervision of representatives of the U.S. Department of Agriculture. All loading of trucks for shipment to the United States is inspected, both at the packinghouse and at the border, for plant material that might carry the blackfly--and other pests into the United States.

Tangerines packed for export, at right; for domestic sale, above.

Citrus fruit shippers state that exports are an important part of their business even though the usual volume is a small part of total marketing. They point out that it is a necessary "other" outlet which has stabilized the domestic market. The new processing plants are another outlet for fruit and another stabilizing factor. When market prices in Mexico are too low, according to shippers, fruit may always be packed for export.

Tamaulipas

East of Nuevo Leon is the State of Tamaulipas, which has a thin northern corridor along Texas. This State represents the southern extension of Mexico's major commercial industry. The most important orange plantings are near the city of Victoria, with the centers of production at Guemez and Hidalgo. Another growing orange producing area is to be found near Padilla. South of Victoria, commercial lime plantings are located near the town of Llera.

Citrus plantings in this State are scattered, most are irrigated, and all are at elevations ranging from 100 to 1,000 feet. While this is a more southern citrus growing area, it is still occasionally subject to frost damage. Both trees and fruit were frozen at the time of the Texas freeze of 1951. In January 1962, fruit was frozen around Victoria and some foliage was killed. The freeze damage was observed to begin about 10 miles south of Victoria.

This is a growing citrus area which is estimated to contain about 1 million orange trees (13,000 acres) in 1961, compared with about 600,000 trees in 1951. This State is now estimated to contain about 275,000 lime trees (3,000 acres), and small plantings of tangerines.

Trade sources indicate that in the past 8 years nearly half a million orange trees have been planted in the vicinity of the town of Victoria, and 80 to 90 percent of these new plantings are Valencia oranges. In 1961, there were an estimated one-quarter million orange trees in citrus nurseries in the State, indicating that planting may be expected to expand. These nursery trees were said to be available to growers at a cost of $0.24 to $0.40 each.

The groves seen were well planted, with a density of 60 to 70 trees per acre. All tillage is by tractor and practically all of the groves are irrigated. A new dam is under consideration and, if this is brought to reality, an additional 10,000 to 30,000 acres could be brought under irrigation in this area. Practically all of this acreage is in a climatic zone where citrus production is possible.

Most of the orange and lime production from this State is sold in Mexico's domestic market; however, there is one well-equipped fresh fruit packinghouse at El Carmen. This plant, like many in Nuevo Leon, is equipped with machinery to color-add early oranges. Both by reason of the quality of the fruit and proximity to the border, this is a potential area for sizable quantities of export oranges.

A large citrus processing plant operated by a Mexican Government agency is located at Llera. Most limes produced in this area and some oranges from all over the State are processed in this plant.

The groves observed near Llera seemed in rather poor condition and little expansion in this area should be expected. However, new lime plantings were observed near Mante and the vigorous new orange groves near the city of Victoria seemed to assure this State a place of increasing importance in Mexico's commercial citrus industry.

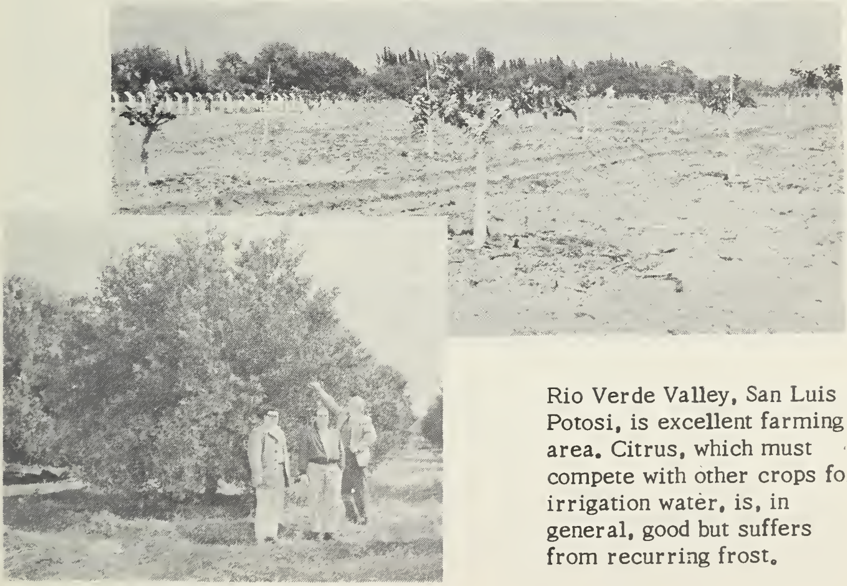
San Luis Potosi

Rio Verde.--In 1961 this was the most important citrus area in the State of San Luis Potosi. It lies about 85 miles east of the City of San Luis Potosi, and is accessible by an excellent all-weather highway, which goes over a pass of about 10,000 feet to reach the valley floor at an elevation of about 3,000 feet.

In 1961, trade sources estimated that the valley contained an estimated 1 million producing citrus trees, (11,000 acres), which represents an increase of about 4,000 acres since 1951. In addition to the producing trees, there may be as many as 100,000 orange and tangerine trees not yet in bearing. Observations indicate that there has been some loss of producing area, as evidenced by "skips" in groves and by the remnants of former producing areas. This retraction in producing areas is probably due mostly to frost damage. For this reason the new plantings are not a net increase in the planted area.

In the last 10 years there has been little change in the character of this area. The primary variety is still the Valencia orange, and this is followed by tangerines, San Miguel, common seeded oranges, and a small production of Washington Navels.

The size of fruit observed was very large, and the oranges were not of uniformly good grade. The tangerine crop observed was very heavy and the fruit of excellent eating quality and color. Some of this fruit being harvested was so clean that it was taken directly to the packinghouse and packed for sale in Mexico without treatment of any kind.



Rio Verde Valley, San Luis Potosi, is excellent farming area. Citrus, which must compete with other crops for irrigation water, is, in general, good but suffers from recurring frost.

In the orange groves visited, the fruit seemed to be of a wide range in size, some exceedingly large and some of normal size, which may indicate that the set of fruit is the result of a bloom extending over a period of considerable time. In such groves it was also observed that there was a very large crop of off-bloom fruit which would not mature until late in the summer. While the off-bloom set may be the result of climatic conditions, it also may indicate poor cultural care.

All of the trees are raised on sour orange roots and practically the entire area is irrigated. There are abundant supplies of water, both from the river and warm mineral springs. Cotton, sugarcane, and vegetable crops compete with citrus for the use of irrigated land. The soil is deep alluvial brown and black loams. The planting density seems to be about 70 to 90 trees per acre, and the trees crowd when they reach mature size.

The groves are clean, cultivated with tractors, and most are fertilized with both manure and chemical fertilizers. The major pests are reported to be red spider and rust mite, and the fungus Melanose was observed on some fruit in packinghouses. Dusting with sulfur is used to control rust mite and spraying with copper sulfate, to control the fungus disease. The general cultural care observed was less than optimum, and it was observed that dead wood from frost damage was allowed to remain in commercial groves.

This area is subject to frost damage; both fruit and trees were severely damaged in the freeze which hurt Texas in 1951, but little damage was reported from the 1962 freeze. Some frost is experienced in most years; in 1960 there was one in February and another in April.

As a part of disease control it was observed in some groves that the earth is removed from around the trunk of the trees, forming a basin to keep this area dry and thus prevent fungus diseases.

Gummosis and psorosis outbreaks were observed in mature groves. These diseases will tend to limit yield. Since there is no bud certification program, the virus psorosis will continue to be a problem in new plantings.

While no minor element deficiency was evident from the condition of the leaves, the foliage seemed to be smaller than in a grove which was in the best of condition. The rate of tree growth in this area seems to be considerably slower than in the eastern States of Mexico.

Costs were extremely reasonable in 1961. The wages of field labor without fringe benefits were reported to be 7 pesos ($0.56) per day. Pickers harvesting tangerines were reported to be paid 3 pesos ($0.24) per thousand fruit for clip picking ($0.06 per box of 250 fruit). Irrigation water is reported to cost about $1.00 per acre per year. The total cash cultural cost per acre in this area probably does not exceed $25.00 per acre per year in groves operated in optimum condition, and is considerably less than this in most groves. The average yield of oranges probably does not exceed three 90-pound boxes per tree; however, the very heavy crop of tangerines indicates that this is a fine tangerine district and, in one grove visited, 20-year-old trees were picking out at 3,000 to 4,000 fruits per tree. In spite of the very excellent crop, the fruits were of fine size.

Some Rio Verde growers expose the tree roots to control diseases.

Most of the production from this area is marketed in the interior undiscriminating Mexican markets. Most of it is shipped to these markets in bulk. However, in January 1961, some well-colored and fine-quality tangerines were being packed in 40-pound boxes for sale in Mexico City. Fruit from this area can be trucked to Mexico in about 8 to 10 hours at a cost of about $0.32 per 70-pound box.

One modern packinghouse has been constructed in this district.

Some fruit from this area is shipped to the new citrus processing plant at Irapuato.

Some tangerines of excellent quality from this area are exported to the United States. Oranges are also exported from this area at times when such exports return higher prices than the domestic market. While oranges from this area undoubtedly have good eating and keeping quality, they do not seem to have any outstanding competitive advantage which would make them acceptable in export markets. The fruit seen indicates that there is a lack of uniformity of quality in most groves.

Observation in this area confirms that fine-quality fruit is being produced. There is also ample irrigated acreage on which orange plantings could be greatly expanded. The cultural practices followed, however, are casual rather than intensive and for this reason the quality of fruit which might make this area competitive in exports is unlikely to be realized. Recurring frost may also be expected to limit the production potential. In the future, this area may be expected to continue to supply primarily the interior markets of Mexico, including the new citrus juice plant.

Valles.--On the eastern coastal plains of the State of San Luis Potosi, citrus is grown near the towns of Valles, Tamazunchale, and Tamuin. In the past 10 years, citrus plantings have increased in this part of the State from 300,000 trees in 1951 to an estimated high of 1.3 million trees in 1961. Total commercial citrus acreage is estimated at approximately 9,000 acres.

The production of grapefruit and tangerines is said to be declining and some lime groves have been abandoned and are being replanted with oranges.

Over 85 percent of the acreage is estimated to be Valencia oranges; this is primarily a district of young trees, with the majority of plantings estimated to be 6 to 10 years old in 1961. Very few trees are over 15 years of age.[3]

The humidity in this area tends to be high and so is the annual rainfall. However, citrus plantings on the coastal valley, as around the city of Valles, are irrigated part of the year. Some of the groves on sloping ground at higher elevation near Tamazunchale are unirrigated.

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[3] According to Engineer Salvador Sanchez Colin.

The fruit produced in this area is of much the same quality as that from the State of Veracruz. The fruit is disfigured with melanose and rust mite.

The yield of fruit is variable, ranging from four boxes per tree in the best cultivated groves to an average of about two boxes per tree in most plantings of 15 years of age.

No export-quality fruit is grown in this area. All of the fruit is sold in Mexico's domestic market, and Mexico City is the primary outlet.

In the future, orange production will probably increase but the area is unlikely to become a major orange producer.

Veracruz

Veracruz is the second most important citrus producing State in Mexico and one of Mexico City's major sources of oranges. In 1961, the estimated total citrus plantings were $5\frac{1}{2}$ million trees and, of this number, about 3 million trees may be considered to be commercial, including 40,000 acres of oranges, 2,000 acres of limes, and about 1,000 acres of grapefruit and tangerines. There has been little change in the total planted area in this State in the past 10 years, as the expansion in some areas has about equaled the removal of trees in others.

This situation is likely to continue unless low coffee prices stimulate an interest in citrus planting. Even if this should happen, the rather poor grade fruit produced at Veracruz will put it at a disadvantage compared with the clean citrus produced in Nuevo Leon. As the competition with Nuevo Leon increases, more and more citrus from Veracruz will probably be processed.

Orange tree in Fortin, Veracruz, though stunted, is in one of the better groves. Area is declining.

The total orange production of the State is said to average 7.5 million boxes. Citrus in this State is raised almost entirely without irrigation and is largely an interplanted crop with coffee or bananas.

In 1961, field labor in the State was said to be paid \$0.56 to \$1.20 per day. Pickers were said to be paid about 5 cents per 70-pound box. These wages for picking include picking and carting of the picked fruit to roadside.

The economy of this region is dependent on coffee and, therefore, the value of the land varies in accordance with the fortunes of the coffee industry. In 1961, citrus land interplanted with coffee was being sold for about 60,000 pesos per hectare ($2,000 per acre). A few years previous, when coffee prices were high, the value of land was double this level.

In 1960, oranges for the domestic market are reported to have been sold from November to March for 50 to 60 pesos per thousand ($0.81 to $0.97 per 70-lb. box). The Valencia oranges harvested April to August brought a higher price of 100 to 125 pesos per thousand ($1.62 to $2.03 per 70-lb. box).

The last 10 years has seen little change in the marketing of citrus in the State of Veracruz. It is still sold in the traditional manner, being pull-picked from the trees and shipped to Mexico's domestic market in bulk. This is ungraded, unwashed, orchard-run fruit. Because of the very tropical conditions under which it is grown, it is usually covered with disfiguring blemishes from rust mite and melanose. Processing is the other major outlet for this fruit.

As the Mexican domestic market becomes more discriminating, the Veracruz citrus is going to be more and more at a disadvantage. In the Fortin area this is being felt, as it is now very difficult to sell their half-green and half-colored tangerines. The Mexican market prefers the highly colored tangerines from the more northern citrus areas.

Coatepec.--The most important producing area is near the capital of Veracruz at Jalapa, and in the adjacent coffee-producing areas surrounding Coatepec. In this area, citrus is almost entirely mixed planted with coffee and leguminous shade trees. In 1961, the plantings were said to consist of about 64 percent corriente, common seeded oranges, 13 percent Valencia, about 9 percent tangerines, 11 percent Navel oranges, and only 1 percent grapefruit.[4] The seeded corriente orange is the most important, since the Valencia variety has failed to produce satisfactorily when grown interplanted with coffee and shade trees.

Cultural care of citrus is a part of the care of coffee. Weeds are usually cut twice per year. When prices of coffee make increased production desirable, the citrus and coffee plants are fertilized with nitrogen fertilizer. A part of the planted area is sweet orange seedlings, but some of the seedling planting and Valencia oranges are budded on sour orange rootstock. The most important pests are rust mite, purple scale, and both the Mexican and white fruit fly. Due to the sloping terrain of most groves and the interplanting with coffee, there is little attempt to do any spraying for citrus pests. Since there is heavy non-citrus vegetation around the citrus groves, a degree of biological control is attained.

Some of the budded orange trees were observed to have the virus disease, psorosis, and the fungus gummosis is a problem in both seedlings and budded groves. Some growers paint the tree trunks with a fungicide to retard gummosis.

The yield of citrus in this area varies greatly between solid plantings and mixed shaded plantings. The trade estimates that the average range of yields from an unshaded grove is about 10 to 20 metric tons per hectare (127 to 255, 70-lb. boxes per acre), and the average yield from a mixed planting with coffee ranges from 5 to 10 metric tons per hectare (64 to 127, 70-lb. boxes per acre). Coffee is the most important crop and it is picked first in preference to citrus. In the 1960-61 season, the crop of coffee was late which resulted in oranges being picked first. In this season the crop was small but the harvest was larger due to the early picking.

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[4] Estimates of Engineer Salvador Sanchez Colin.

The crop of oranges from the State of Veracruz, therefore, depends to some extent on both the price and the season of coffee.

Fortin.--The Fortin-Cordova area of Veracruz has changed greatly in the past 10 years. In 1951, this was a growing citrus area with many new nurseries and new plantings. In 1961, one inquires, "Where is the citrus?" In the past 10 years over half of the citrus plantings have been removed. The remaining groves are mostly in a very poor or abandoned condition. Only a few enterprising growers are still making a business out of raising citrus in this area. As at Veracruz, citrus is raised without irrigation; the groves are mostly shade-grown seedlings.

Labor in this area is said to be paid 7 to 8 pesos ($0.56 to $0.64) per day. While labor is cheap, it is difficult to grow and market citrus because of the very rough country roads and the heavy growth of natural vegetation from abundant rainfall.

The new crops are coffee and tobacco, and these are taking over in importance from citrus. Although some commercial citrus is still raised here, growers are finding it difficult to sell their fruit. In 1960, growers were said to have sold seedling oranges for about 80 cents per 70-pound box. In the summertime the price for Valencia oranges is said to be about twice this.

This citrus area has become a very minor citrus-producing area and the outlook is for it to decline further.

Other Areas.--While this old citrus area is declining, new ones are coming on. One of these is in the coastal plain north of Veracruz where plantings are found in the vicinity of Martinez de la Torre. At this and other nearby areas, there are said to be over one-half million trees which range in age from young plantings to groves of 15 years or more. This is a low area with a humid climate and it is said that the seedling oranges produce better than the Valencia variety. It is also reported that some of the unshaded Valencia groves grown here indicate that they will be able to produce commercial crops.

Another new area is to be found even further north in the vicinity of Tuxpan. In this general area there is said to be about half a million young trees and it is reported that the major part of the groves here are less than 10 years of age. In this area the Valencia is the major variety but seedlings and Washington Navels are also grown as well as tangerines and grapefruit.

Scattered citrus plantings are also to be found in the plains immediately surrounding the town of Veracruz. Small quantities of good-quality grapefruit are produced in this humid climate. There are also scattered plantings of limes. It was observed at some of the older lime groves in this area were declining and some were in an abandoned condition. This is further indication of the unprofitableness of the lime industry.

There is no indication of a growing citrus industry in the vicinity of Veracruz. It may be assumed that this area will remain roughly the same size, providing mostly fruit for local consumption and some limes for shipment to interior markets in Mexico City, and small quantities for processing.

Jalisco

Scattered citrus plantings through this central Mexican State are estimated to total about 3,000 acres of oranges and about 2,000 acres of other citrus, including limes, sweet lemons, and grapefruit.[5] While there are many small plantings, the major commercial industry is centered near the town of Atotonilco El Alto, where an estimated 1,500 acres of citrus is planted, and near the town Ayo El Chico, where citrus plantings are estimated to total about 600 acres.

All citrus plantings in this State are at elevations from 6,000 to 7,000 feet; all plantings are irrigated and most are at least partly cultivated by hand. In spite of the high elevation this area is not subject to frost damage. This district is unique in that grapefruit rootstock is used in preference to sour orange, which is said to result in a dwarf tree in most districts of this State.

Oranges are the primary citrus variety grown and plantings include seedling oranges called corriente, or San Miguel, some Navels, a local, smooth-skinned oval orange called Escalon, and Valencias. Sweet lemons, limes, and fine-quality tangerines are also produced in the major commercial plantings.

Field observations in 1961 indicated that most groves received rather poor cultural care. There was little evidence of any expansion in the major citrus districts. It was noted that some orange and tangerine groves were being interplanted with young sweet lemon trees. Present plantings are mostly in rather narrow

Typical of the small citrus industry at Atotonilco el Alto and Ayo el Chico, Jalisco, are the tangerine groves (right) and the sweet lemons interplanted with oranges (at the left).

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[5] As estimated by Engineer Salvador Sanchez Colin.

valleys which have only small areas that could be brought under irrigation and planted to citrus. It is possible that there are areas in the State which could produce citrus if land were brought under irrigation. Only a major irrigation development would make this possible.

All the citrus in this State is sold in the domestic market and no export packinghouses exist. Guadalajara is the major market and is likely to remain so in the near future. The construction of modern paved roads to Jalisco citrus areas has made interior markets more accessible. While road building has been an aid to marketing citrus it has also brought competition, as it makes it possible to ship oranges to interior Mexican markets from Nuevo Leon and Veracruz.

In the immediate future, Jalisco is likely to remain a citrus area of minor importance, producing no citrus for export and only small supplies for Mexico's processing industry.

Sinaloa and Sonora[6]

Both of these west coast States bordering on the Gulf of California have growing citrus industries. The center of production in the State of Sonora is around the town of Hermosillo where there are said to be about one-quarter million trees planted. There are also about 40,000 orange trees planted on the coast near Guaymas and Empalme. A little further south there is a small citrus planting near Ciudad Obregon. In 1961, citrus plantings probably totaled 3,000 acres.

In the adjoining State of Sinaloa there is a small planting of grapefruit near the town of Los Mochis and another small citrus area is reported further south on the coast between the towns of Culiacan and El Dorado. Plantings in 1961 probably totaled 500 to 1,000 acres of citrus.

As the production from these areas expand, a market for part of the supplies will probably be the Mexican border towns. In 1961 and 1962, an embargo was placed on the import of U.S. fruit into Lower California, for a period, in order to assist in the marketing of fruit supplies from these Mexican States.

Growing production in these two States will probably mean not alone smaller California exports to Mexican border towns, but also a greater quarantine problem against Mexican citrus pests.

The Plant Pest Control Division, Agricultural Research Service, U.S. Department of Agriculture, operates a quarantine surveillance program in Sonora at several quarantine stations. One of these stations operates between the towns of Guaymas and Hermosillo. Another quarantine station is in operation north of Hermosillo near the town of Begamin Hill. These serve the purpose of preventing the transport of citrus infestations north of those points. When citrus from these producing areas is transported to Mexican border towns, such as Tijuana, the fruit is fumigated at these stations to prevent carrying the Mexican pests to the border.

Colima

Colima's growing lime industry is now Mexico's major source of limes, both for export and the domestic market. About 8 years ago, the largest production was in the State of Michoacan near the town of Apatzingan. In recent years, however, no more than 20 percent of its limes have been of export quality compared with 80 percent in 1950.

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[6] Information from W. P. Patton and David Trevino, Plant Pest Control Division, ARS.

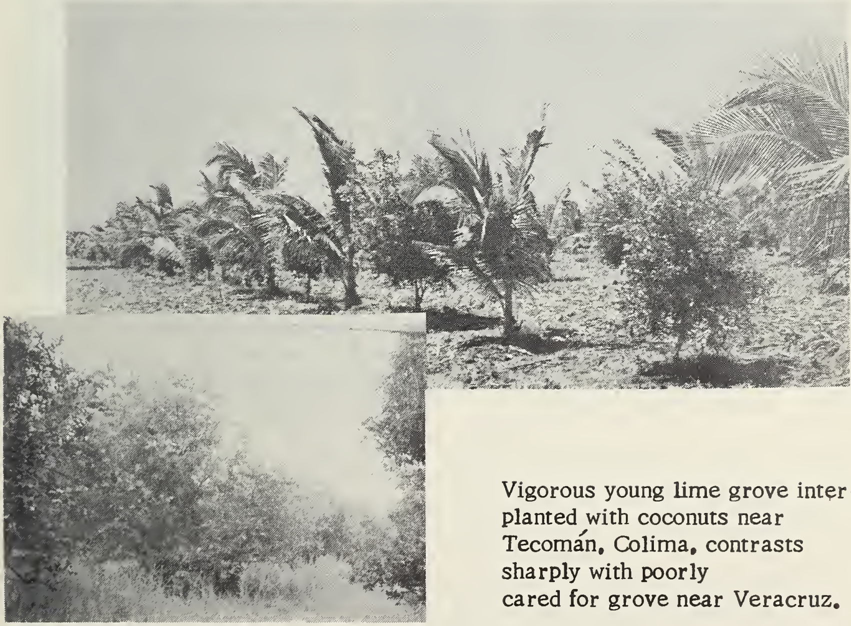
In 1961, trade sources estimated that the total plantings of limes in Colima were about 1,400,000 trees. While the trade estimated that about 10 percent of these were not as yet in production, observation in the field would indicate that a larger percentage is yet to come into full bearing. The total commercial lime plantings of all ages was probably 14,000 acres in 1961.

The trade estimates that about 35,000 metric tons of limes are harvested here each year. This would represent harvested production since the actual quantity of limes produced is always much larger since a part of each year's crop is not picked. Field observations indicate that the total production can increase by 25 to 50 percent in the next 10 years.

Lime production has now moved out of the vicinity of the city of Colima to the coastal plains of Tecomán. Most limes are grown as mixed plantings with coconuts or bananas. Very few solid plantings of limes were observed.

In mixed plantings, the coconuts and limes are planted at the same time so the young lime trees can grow to a normal shape and size before they become shaded.

In 1958 a very severe hurricane struck this area with estimated wind velocity of 150 miles per hour. Lime trees were uprooted in the rain-drenched groves. Where attempts were made to rehabilitate the damage by pulling the trees back into position, it was observed that under shade the lime trees do not attain a normal shape but grow in an upright pattern toward the sunlight.



Vigorous young lime grove interplanted with coconuts near Tecomán, Colima, contrasts sharply with poorly cared for grove near Veracruz.

The soil at Tecomán is a deep alluvial, sandy loam which is virtually virgin soil since all of it has only been cleared from the Monte about 15 years and some of the groves are on land that has only been cleared a matter of 2 or 3 years. The trees observed were growing vigorously and rapidly.

There appears to be few pests or diseases that affect the limes in this area. The black fly has been brought under biological control. No infestation of black fly was observed. No spraying is done in most groves for insects or scale pests. The area has the Mexican fruit fly which does not affect the limes, but this would be a detriment to growing of oranges, tangerines, or grapefruit in this area.

The newer planted groves on virgin soil need no fertilization; however, some of the older groves are fertilized with sulfate of potassium and sulfate of ammonia. Nearly all of the groves are irrigated, mostly by gravity water supplemented by some pumped water when gravity supplies are unavailable. The water table is surprisingly deep in this area; most of the irrigation water is pumped from a depth of at least 100 feet. Diesel power is used for these pumping plants.

Limes are still grown as seedlings and none are reported to be propagated on different rootstocks.

Growers report that there is some difficulty with gummosis, but few outbreaks were observed in the groves seen. Growers also reported that a "die-back" has recently developed. The outbreak of this so-called die-back was observed in only one small grove. It is thought to be the result of nematode damage.

The groves are cultivated with tractor-drawn disc harrows and the cultivation was observed to be rather deep in the mixed planted orchards.

This tropical area of Tecomán is at an elevation of about 30 feet above sea level. The average rainfall is over 20 inches per year; irrigation is used during dry periods.

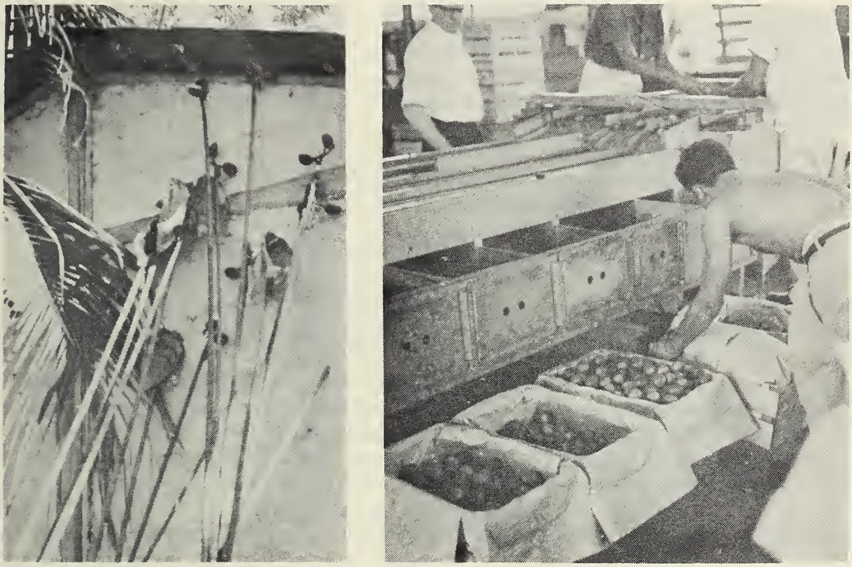
Cultural costs are difficult to evaluate since practically all of the orchards are mixed planted with other crops. Much the same cultural care would be given the groves if no limes were planted. The only specific cultural cost in the older lime groves is the fertilizer which might be applied and some pruning. In 1961, field labor in this area was reported to be paid 12 to 15 pesos per day, ($0.96 to $1.20). Most of the labor was reported to receive about $1.20 per day. The two greatest costs are cultivation by tractor and irrigation. Water for irrigation from both gravity and pump sources may cost as much as $30.00 per acre per year. Tractor cultivation may cost $15.00 to $20.00 per acre per year. In 1961, seedling lime trees for planting in the grove could be purchased for 7 cents each. The total cultural cost for a mixed planted lime grove with either coconuts or bananas probably does not exceed $50.00 per year. Since these are mixed plantings and involve joint costs, only a small part of this could be calculated to the cost of producing limes. Lime production is a supplement to other crops.

In 1961, trade sources reported that a producing lime grove interplanted with coconuts could be purchased for about $500.00 per acre.

Picking is a considerable part of marketing costs. Since the fruit is picked from the thorny trees, usually by cuplike pickers mounted on a pole or by snapping the low fruit by hand or by pulling the fruit, the process is slow and expensive. In 1961, pickers were reported to be paid 2 to 3 pesos per 30-kilo box (\$0.18 to \$0.28 per 76-lb. box). This cost of picking is the same whether the fruit is for export, the domestic market, or the products factory.

At the packing plant the fruit is sent both to export and the domestic market graded and sized in five sizes and loose-packed in paper-lined 30-kilo boxes. These wooden boxes are reported to cost the plant about 3½ pesos (\$0.28) each, including the cost of the nails and making the box.

The marketing of fresh limes has changed in the past 10 years. In former years most of the fruit was bought by fresh fruit buyers who in turn exported or sold it to the domestic market. In the past 5 years, cooperatives or "unions" have been formed. One of these had 72 growers in 1961. Members of this group marketed their fruit together and also processed their own fruit. They own a packinghouse for this purpose and were obviously interested in obtaining orderly marketing.



In Colima, limes are picked with poles like those at the left, equipped with "cups," and are sent to both domestic and foreign markets in paper-lined field boxes (at right).

Michoacan

This west coast State is the second most important source of limes. The center of production is in a valley of about 1,000 feet elevation, centered around the town of Apatzingan.

In the past this area was Mexico's major source of commercial limes and, in 1951, it contained an estimated 900,000 lime trees planted on about 15,000 acres. In 1961, this was a declining area and commercial plantings were estimated at about 400,000 trees, about 6,000 acres.

In recent years, as the production of cotton and winter vegetables, including melons, has increased, the production of limes has lost out to these more profitable crops. In 1961, field observations indicated that about 50 percent of the lime groves were in an abandoned condition, about 40 percent had poor care, and only about 10 percent could be considered well cared for. No new plantings were observed and it may be assumed that the quantity of limes produced in Apatzingan will decline substantially in the next 10 years.

Near Apatzingan there are several large "ejidos," communal agricultural enterprises, which engage in the production of limes. The two most important of these are Nueva, Italia and Lombardia. The ejidos' lime groves seem to be in slightly better condition than the average privately owned lime groves. Trade sources indicate that in the recent past there were as many as 3,000 private lime growers in this area, but in 1961, about 40 percent of the total lime acreage was said to be on "ejidos," and about 60 percent of the lime acreage was operated by private owners.

The soil in this area is heavy, and green manure crops are a desirable cultural practice. The groves have to be irrigated for a part of the year and there seems to be abundant water available for this purpose and for an expansion of the irrigated acreage. A new dam and a hydro-electric power plant will assure the agricultural future of this area.

In 1951, the black fly was a major pest but in 1961, most growers did not spray since a biological control had been attained over this major insect pest. The cultivation of the groves with tractors is a major cultural operation.

Due to the importance of the winter vegetable industry, this is one of the relatively high wage areas in Mexico. Field labor is said to be paid 12 to 15 pesos ($0.96 to $1.20) per day, and shed labor in packinghouses is reported to be paid 18 to 24 pesos ($1.24 to $1.92) per day.

Picking the fruit is a major cost and, in the season of small production, workers are said to be paid $0.36 per 76-pound box. In June to August the pickers are paid about 16 cents for picking a box of limes because of the more abundant supplies of fruit. When dropped limes are picked for industrial use, the pickers are said to be paid about $0.10 per box.

The estimated cash cost of operating a lime grove shown in table 4 represents the cost of the best cared-for groves. It will be

TABLE 4.--Estimated cash cultural cost of operating a lime grove at Apatzingan, Mexico, 1961

Item	Cost		Item	Cost	
	Pesos per hectare	*U.S. dol. per acre*		*Pesos per hectare*	*U.S. dol. per acre*
Administrator................	600	19.43	Fuel for tractors..........	292	9.45
Foreman.....................	180	5.83	Amortization of equipment...	200	6.47
Labor			Fertilizers................	120	3.89
Truck and car drivers.......	156	5.05	Taxes......................	--	nominal
Tractor operators..........	292	9.45			
Irrigation.................	204	6.60	Total cultural cost.....	2,504	81.06
Other cultural labor........	268	8.67	Picking....................	1,005	32.54
Electricity for pumping, etc..	192	6.22			

Converted at 12.49 pesos to the dollar.

Source: The trade.

noticed that over $20.00 of this cost per acre is that of administration. If this is deducted from the total, the cash cost of operating an acre of limes in 1961 was estimated at about $60.00 per acre. It may be assumed that most of the lime groves are operated for a cash cost of less than half of this amount. It is interesting to note that the estimated cost of picking limes may be nearly equal to the cash cost of operating the groves.

As the production in the area has declined, the marketing of limes has also changed. When Apatzingan was a major lime producing area there were many small fresh lime packing plants and five or six processing plants which produced essential oil of lime. In 1961, practically all of the limes, both fresh and for processing, were handled by the one big plant which is financed by a Mexican Government bank which also serves the ejidos. Since this organization is controlled by the government, it is obligated to take all of the limes which are offered regardless of the marketing opportunities. In 1960, the plant is reported to have paid about 34 to 35 centavos per kilo ($0.86 to $0.89 per 70-lb.) for limes at the plant. The fruit received was packed for sale in the domestic market and export, and the balance was used for products. The products produced were distilled and cold-pressed lime oil, citric acid, calcium citrate, concentrated lime juice, and the dehydrated peel for cattle food. The lime juice concentrate is a hot pack product concentrated 5 to 1. While it is concentrated it is also preserved with SO_2 and it is shipped to the domestic market and to England in wooden casks. The essential oil of lime is packed in 50-gallon steel drums.

Because the plant has to take all of the limes which are offered, it is said that this results in the production in Mexico of about 600,000 pounds of lime oil per year, when there is a market for about 300,000 pounds. In 1961, there was said to be very large stocks of stored lime oil.

In 1961, limes were no longer a profitable crop in Apatzingan for most growers. The growing interest in the production of winter vegetables and melons and the resulting drain on the labor market and the competition for irrigated land indicate that this is a declining lime producing area which will be of minor importance in the next 10 years.

Experiment Stations

Mexico does not have an extensive government program on citrus experimentation; however, offices of the "Defensa Agricola" are to be found throughout Mexico's citrus areas. The most intensive experimental effort has been the cooperative "blackfly" program with the Agricultural Research Service of the U.S. Department of Agriculture.

The only citrus experiment station seen was near Montemorelos in Nuevo Leon. Experimental work here is financed partly by citrus growers, and work includes soil analysis, irrigation, and pest control.

Citrus experimentation may be given impetus in the future as the Rockefeller Foundation in Mexico is reported to be considering citrus experimentation as a part of their program of assistance to Mexican agriculture.

The Blackfly Program

The success of biological control of the blackfly in Mexico has been of major importance to the Mexican citrus industry.

In 1951, the blackfly was a major pest, destroying citrus groves in Valles, Colima, and Apatzingan. At this time commercial control was being obtained in some areas by spraying, and biological control was in the experimental stages.

Field observations in 1961 gave evidence of the success attained by biological control in the last 10 years. While the blackfly is still present and surveillance is still maintained by USDA's Plant Pest Control and Plant Quarantine Divisions, it is no longer a major pest. No heavy infestations were seen in any district visited, and no tree damage from the blackfly was observed.

The blackfly is still in Mexico, but it is no longer of major importance in reducing Mexico's citrus production.

Biological control has been attained through the work of USDA scientists who discovered and introduced a predatory wasp.

The control program in Mexico has been a cooperative activity between the Mexican and U.S. Departments of Agriculture, and the success attained is a fine tribute to all who engaged in it and continue the surveillance.

The development of this cooperative program and some of its activities are outlined in the Appendix.

Marketing

Domestic Marketing

The requirements of Mexico's domestic citrus market have changed markedly in the past 8 years, owing to the growth of supermarkets and the increase in spendable income. In the past, Mexico was supplied entirely by field-run fruit which was sent to the market unwashed, ungraded, or packed in any way. In 1961, most of Mexico's domestic urban centers were still being supplied by fruit of this type, but there was an indication that demand for graded and sized fruit was increasing and for a part of the season, major markets, such as Mexico City and Guadalajara, buy fruit which has been graded, washed, waxed, and roughly sized.

This fruit is picked and brought to the packinghouse where it goes through much the same treatment as fruit for export. In sizing, roughly two general groups of sizes are separated: sizes 200 and larger for the larger internal markets, Mexico and Guadalajara; and 200 and smaller for other markets of Mexico. Shippers report that when the market is highly competitive it is a distinct advantage to send sized, washed, and waxed fruit to market. A premium is paid for fruit thus prepared. Shippers report that the cost of picking this fruit, bringing it to the packinghouse, washing, waxing, and sizing, and loading on the trucks for transport to Mexico costs from $0.19 to $0.25 per 70-pound box. This is the beginning of orderly citrus marketing in Mexico. Some of the farsighted shippers estimate that in another 10 years most citrus will be packed in some way or another for domestic use. The tendency toward more orderly domestic marketing in Mexico greatly increases Mexico's potential as a citrus exporter.

The growth of supermarkets, which now package some of the bulk citrus in Mexico City, will probably be the first to demand packaged citrus from the shippers.

Lime groves in Apatzingan, Michoacan. Very few are thriving; most have been abandoned like the one at the right, for cotton and winter vegetables are now the favored crops.

The Merced Market in Mexico City is the largest in Mexico, and the prices paid here influence domestic prices throughout Mexico and determine the profitableness of exports. The low prices paid for limes indicate the depressed condition of this market. In 1959, limes sold for as little as 2 cents per dozen in September. In 1960, the prices were slightly higher, averaging about 5 cents per dozen. In Mexico the lime is widely used and serves all the purposes of the lemon in the United States. The comparison of orange prices is equally significant. A few years

TABLE 5.--Wholesale prices for citrus, Mexico City, January 1959 to August 1960

Year and month	Oranges		Limes
	Fancy	Straight run	
	U.S. dol. per doz.	*U.S. dol. per doz.*	*U.S. dol. per doz.*
1959:			
January	0.15	0.09	0.06
February	.17	.11	.11
March	.17	.10	.10
April	.22	.14	.08
May	.22	.16	.05
June	.22	.16	.04
July	.27	.23	.04
August	.30	.17	.03
September	.19	.07	.02
October	.10	.06	.03
November	.12	.06	.03
December	.21	.07	.04
1960:			
January	.21	.08	.05
February	.15	.08	.05
March	.15	.10	.06
April	.18	.11	.07
May	.19	.12	.05
June	.21	.14	.05
July	.27	.15	.05
August	.34	.21	.06

Direccion General De Economia Agricola, as reported by the agricultural attache, converted at the rate of 12.49 pesos to the dollar.

ago only one quality of fruit was sold in Mexico; now two grades are quoted in the official prices. The premium paid for fancy oranges is a fine example of the changes that have taken place in domestic marketing of citrus in Mexico. In December 1959, the wholesale price of straight-run oranges was only 7 cents a dozen compared with 21 cents per dozen for fancy-grade oranges. In March 1960, straight-run oranges were selling for 10 cents per dozen wholesale compared to 15 cents per dozen for fancy fruit; this premium is not as dramatic as that of the preceding December, but it is still a substantial difference. It is premiums such as this for good-quality fruit which will stimulate the development of orderly marketing.

These data also illustrate the seasonality of Mexico's citrus prices. In the 1959-60 season the lowest prices were paid from October 1959 to April 1960. Straight-run oranges started the season at a price of about 6 cents per dozen, when they were probably immature, rising to about 11 cents per dozen wholesale toward the end of the season in April. Fancy oranges, probably immature, began the season at a price of only 10 cents per dozen in October, but by December and January the price was double this figure, then dropping to 15 cents per dozen in February and March and increasing again to 18 and 19 cents per dozen in April and May when the Valencia oranges became available and oranges were in short supply. The high prices indicated here for oranges from May to October, when fancy oranges reached a peak of 30 cents per dozen in August 1959, and 34 cents per dozen in August

Left, country retail market displays citrus and other fruit. Top, truckload of bulk oranges at wholesale market, Mexico City.

1960, are the prices of off-season fruit and represent very small volume.

In evaluating these retail prices, it should be kept in mind that while they indicate two grades, both grades are unpacked fruit which is shipped to market in bulk. The wholesale prices paid for fancy fruit are the most significant in evaluating Mexico's potential as a citrus exporter. The average wholesale price for fancy oranges in Mexico City in the 1959-60 marketing season (about 18 cents per dozen) is equivalent to about $3.50 to $4.50 per 70-pound box. With the domestic market offering such prices the export market must offer very much higher prices in order to be attractive because of the cost of packing, the Mexican export tax, and the import duties of foreign markets. The strong domestic Mexican market for good grade oranges is most important to the development of large-scale exports.

Exports

In the past 10 years Mexico's total orange exports have averaged about 300,000 boxes per year except for 1950 and the period of world shortage caused by the 1956 freeze in Spain. There is no trend toward rapid increases.

Once Nuevo Leon recovers from freeze damage, the future pattern of exports will probably be much the same. When short crops result in high world prices, exports will increase. In other years, they will probably range from 500,000 to 1 million boxes per year during the next several years.

The supply of export-quality oranges has been increasing, so Mexico should be capable of exporting as much as 3 million boxes of oranges when world shortages occur after 1965.

Grapefruit exports will remain small and should not exceed 50,000 boxes per year even under the most favorable world market conditions.

Lime exports have declined from 93,000 boxes in 1950 to 27,000 boxes in 1959. In this period the U.S. pack of frozen lemonade has increased from 3 million to nearly 13 million gallons per year, indicating a competitive relationship between these two products.

Mexican lime exports are unlikely to increase in the near future, and in the next 10 years total exports will probably average 35,000 76-pound boxes per year.

Customers.--Most of Mexico's exports are shipped out of U.S. ports and, therefore, official Mexican data on exports indicate the United States as the primary customer. Since Mexico's exports on citrus cannot be shown from Mexican data, data from the importing countries have been used. Mexican official data are useful only in describing trade in fresh limes, since the United States is the primary customer.

Mexico's orange exports to Canada have been less than 100,000 boxes per year except in 1958 and 1960 when short supplies in Europe and the United States resulted in high world market prices. Mexico's export to Western European countries has followed much the same pattern. Trade was heaviest in 1956 and 1957 following the shortages caused by the 1956 freeze in Spain. As Mediterranean supplies returned to normal, Mexican exports decreased. In the future much the same pattern may be expected.

TABLE 6.--Mexican exports of fresh citrus and citrus products, by country of destination, 1959

Country	Oranges	Limes	Orange juice	Lime juice	Orange oil	Lime oil
	1,000 boxes[1]	*1,000 boxes*[1]	*1,000 gal.*[2]	*1,000 gal.*[2]	*1,000 lb.*	*1,000 lb.*
United States	839	27	135	27	5	91
Europe:						
Germany[3]	--	--	33	--	1	([4])
Netherlands	18	--	6	--	1	2
Norway	--	--	13	--	--	--
United Kingdom	--	--	([4])	51	--	4
Total	18	--	52	51	2	6
Latin American republics	--	--	--	([4])	([4])	1
Canada	--	--	37	--	1	--
Grand total	857	27	224	78	8	98

[1] Oranges, 70-lb. boxes; limes, 80-lb. boxes.
[2] Orange converted as frozen concentrate 42° Brix; lime converted as concentrate 10 lb. per gal.
[3] Classification as to East and West Germany not shown.
[4] Less than 500 lb.

Official sources.

TABLE 7.--Mexican oranges: Imports by countries, 1955-60

Calendar year	Canada[1]	Western Europe				
		Germany	Netherlands	Norway	Sweden	Switzerland
	1,000 boxes[2]	*1,000 boxes*[2]	*1,000 boxes*[2]	*1,000 boxes*[2]	*1,000 boxes*[2]	*1,000 boxes*[2]
1955	46	5	201	--	9	--
1956	23	68	78	11	34	--
1957	27	276	361	33	62	2
1958	562	65	194	11	14	--
1959	64	58	64	5	6	([3])
1960	268	14	42	[4] 3	[4] 1	--

[1] Includes tangerines.
[2] 70-lb. boxes.
[3] Less than 500 boxes.
[4] Eight months, January-August.

Official data of importing countries.

Since Mexico is tending to produce larger quantities of export-quality fruit, it is possible that it might be able to supply larger quantities when export opportunities next occur.

Duty Rates.--Mexico has both import and export duties on fresh and processed citrus products (tables 24 and 25).

The export of fresh oranges and grapefruit is subject to an ad valorem duty of only 3 percent, while fresh limes bear an export duty of 10 percent. There is no specific duty on the export of any fresh citrus or citrus products. The ad valorem duty is calculated on the official price or the invoice value, whichever is higher. Official prices are subject to change and therefore the duty rates presented are indicative of conditions in 1961 only.

Export duty rates are utilized to enforce the lime products regulations of the Mexican Government. The export of lime juice and orange juice is exempt from all duty as is orange oil. Lime oil is also exempt when it is exported under the authorization of the Mexican Department of Agriculture and within the official export quota. Lime oil exported outside the quota is subject to duty.

Import duty on citrus and citrus products is assessed as a specific rate plus an ad valorem duty. The duty on the import of fresh fruit is assessed on the gross weight, which includes the weight of the fruit plus the export package. The total duty includes the specific rate based on weight plus the 40 percent ad valorem duty for lemons and the 75 percent ad valorem duty for oranges and grapefruit.

The import duty on orange, grapefruit, and fruit juices is also subject to a specific duty plus an ad valorem duty of 70 percent on fruit juices and 40 percent on orange and grapefruit juices. The specific duty is also based on weight which is computed in "legal" kilos or pounds. This classification includes the weight of the product and the first container but not the weight of the packaging. In applying this duty, concentrated orange juice would be subject to a duty based on the weight of the juice packed in a tin can; the weight of the wooden box in which the can might be packed would not be taxed.

Duty rates are also assessed in accordance with the concentration of the juice. Citrus juices which have a specific gravity up to and including 1.25, or less than 53.3° Brix, have a lower duty than do juices of higher concentration. Under Mexico's duty schedule, single-strength and frozen orange juice concentrate bear a much smaller duty than 65° Brix concentrate.

The import duties discussed here apply to sales in practically all of Mexico, but excludes a so-called free zone. This free zone runs parallel to the California border and includes some of the areas which are isolated from the rest of Mexico as are the border towns of lower California-Mexico. This free zone also has its restrictions. Trade may be stopped at any time when the Mexican Government determines it to be disadvantageous to the Mexican industry. Nearly all of the U.S. exports of fresh citrus and citrus products to Mexico record sales to border towns in the zone which is usually free of duty. A small quantity of U.S. citrus juices is offered for sale in Mexico City, but the price makes the juices a very expensive specialty.

As the Mexican citrus industry grows, the free zone may be increasingly subject to restriction and U.S. trade with Mexico in citrus and citrus products may suffer accordingly. The duty rates in effect in 1961 effectively illustrate the efforts of the Mexican Government to protect its citrus industry.

U.S. Trade With Mexico.--U.S. trade with Mexico has been a two-way street; the United States has imported substantial quantities of citrus from Mexico and Mexico has also been a market for

TABLE 8.--Citrus juice: Retail prices in Mexico City, 1961

Item	Origin	Unit	Price	
			Pesos	U.S. dol.
Orange juice:				
Single-strength	U.S.	No. 2 can	9.00	0.72
Frozen concentrate	Mexico	6-oz. can	2.75	.22
Grapefruit juice:				
Single-strength (sweetened)	Mexico	No. 2 can	2.35-2.55	.19-.20
Blended juice:				
Single-strength (sweetened and unsweetened)	U.S.	No. 2 can	9.00-12.50	.72-1.00

Source: Observations in retail stores.

U.S. fresh citrus. In the 10 years, 1950-60, the United States imported from Mexico 1.4 million boxes of oranges and exported to Mexico 1.3 million boxes. Most of the Mexican exports to the United States occur in the winter season competing with U.S. winter orange production. Most U.S. exports of oranges to Mexico are to border areas near California, primarily in the summer.

TABLE 9.--U.S.-Mexican trade in citrus, by variety and season October 1959 to September 1960

Year and month	Oranges		Lemons & limes		Grapefruit	
	U.S. imports from Mexico	U.S. exports to Mexico[1]	U.S. imports from Mexico	U.S. exports to Mexico	U.S. imports from Mexico	U.S. exports to Mexico
	1,000 84-lb. boxes		*1,000 79-lb. boxes*		*1,000 78-lb. boxes*	
1950	--	43	79	6	--	1
1951	81	68	68	8	2	2
1952	167	78	72	10	4	1
1953	146	112	134	8	(2)	1
1954	57	117	37	11	--	2
1955	47	134	37	19	--	1
1956	71	144	49	26	--	(2)
1957	17	150	38	22	(2)	2
1958	255	67	55	42	2	1
1959	301	176	50	43	(2)	(2)
1960	257	213	58	52	--	3
1959:						
October	1	6	2	2	--	--
November	10	6	1	1	--	--
December	69	11	1	1	--	--
1960:						
January	33	11	1	1	--	--
February	3	19	1	2	--	(2)
March	1	26	5	3	--	(2)
April	--	37	7	5	--	(2)
May	20	22	8	4	--	--
June	49	19	8	5	--	1
July	28	14	7	4	--	(2)
August	4	14	7	5	--	(2)
September	--	15	5	5	--	(2)

[1] Oranges and tangerines; imports of tangerines not separately classified.
[2] Less than 500 boxes.

Mexico's exports to the United States have been larger in the last 3 years, averaging about 300,000 boxes per year, and U.S. exports to Mexico were larger in 1959 and 1960.

In the future, U.S. imports of oranges from Mexico will certainly be larger in years of U.S. shortages. As production on the west coast of Mexico increases, it is possible that this may interfere with U.S. exports to Mexico, and this trade may not continue.

Grapefruit has been a minor item in this trade; there have been small quantities of imports from Mexico and small exports to Mexico. The last 10 years U.S. sales to Mexico have been greater than U.S. imports. Grapefruit will continue to be a small item in U.S.-Mexican fresh citrus trade.

U.S. imports of limes from Mexico have averaged about 50,000 boxes per year in the last decade. Future trade will probably continue to follow this pattern, with little increase in the near future due to competition with frozen U.S. juices.

While U.S. imports of Mexican limes have shown a decreasing tendency, U.S. exports of lemons to Mexico have increased in the past 10 years from about 6,000 boxes in 1950 to over 50,000 boxes in 1960. These U.S. exports are also to border towns near California. Since there is very little production of lemons in Mexico this trade will probably be sustained but it is unlikely that it will exceed 75,000 boxes per year.

Limes for Export.--Most of the Mexican limes imported into the United States enter through Nuevo Laredo. Packing here is carried on by one plant on the Mexican side of the line and by three or four plants in the town of Laredo on the U.S. side.

Lime packers on the American side of the border compete with those on the Mexican side. In Mexico the lime packers are said to pay packinghouse labor about 2 pesos ($0.16) per hour. On the American side, packinghouse labor is paid at least $1.00 per hour. While the labor costs are much lower in Mexico, nails, paper, and machinery are much more expensive.

There has been no change in the packing methods which were observed 7 years ago. Limes are still received from the producing areas in field boxes which weigh 40 to 65 pounds gross, depending upon the source in Mexico. This fruit is usually unsized, and shipments from only a few packing plants are waxed. At the border packing plant the limes are dumped on grading tables where the yellow fruit is picked out and the fruit is then brushed, waxed, and sized. It is then packed loose and unwrapped in paper-lined 40-pound boxes and shipped to a market in the United States. On arrival at destination the fruit is usually regraded and repacked into small containers for sale to retail or institutional trade.

The boxes in which the limes are carried from the border to the U.S. markets are made out of the field boxes in which the fruit is sent from the Mexican producing area.

Each packing plant maintains removable trays under the brushing and waxing tables in order that any leaves or stems may be collected and burned to prevent blackfly infestation in the United States. These plants are under constant surveillance of U.S. Department of Agriculture inspectors.

Importers purchase limes from packers in the producing areas. The price paid depends upon the season of the year. It is usually highest from about December to February, when a 40-pound box of fruit at Colima has been purchased in recent seasons for about $1.76. Some fruit is packed in 55-pound boxes, and the high-season price for this pack is reported to be about $2.48 (31 pesos). The field prices are usually lower between March and November, $1.28 to $1.44 per 40-pound box.

Transport from the producing area to the border packinghouse is still a problem. The rail freight from Colima, the main producing area, to Laredo is reported to be 6 pesos ($0.48) per 40-pound box. The cost of express shipment of a 55-pound box is reported to be 8 pesos and 60 centavos ($0.69) per box, and for truck shipment, 9 to 10 pesos ($0.72 to $0.80). While trucking cost is higher it is said to be quicker and the fruit arrives at the border in better condition.

For the limes produced on the east coast of Mexico in the vicinity of Llera, the cost of truck shipment to Laredo is reported to be 4½ pesos ($0.36) per 40-pound box. While this area has a distinct advantage in freight cost, it is reported that limes from Colima are preferred because of their better keeping qualities.

The bulk of Mexico's lime production is consumed in the domestic market, and export sales make up only a small seasonal market for fruit especially suited to export. Export markets in the United States look on the lime as a green fruit. The lime is naturally yellow when it is ripe. It takes constant regrading of the fruit to maintain its green color by the time it reaches the consumer.

Auction Prices of Mexican Oranges in Europe.--Mexican-European trade is so small that there are only a few opportunities to make a comparison of the competitiveness of Mexican fruit with fruit from other sources. In one comparison (table 10), the December 19, 1956, prices of Mexican "Lisas," a group of mixed early varieties, are good, especially for small fruit; the 40-pound half box sold at higher prices than half boxes of Florida oranges and at about the same price as cartons of California Navels. Later--at the April 10, 1957, sale--full boxes of Mexican Valencias sold at lower prices than cartons of California Valencias and at premiums of about $2.00 per box over Blood Oval oranges from Spain.

At these sales, Mexican fruit was well received and seemed to indicate a competitive advantage over other fruit; however, in this season the Mexican orange was a unique item on the European market and, therefore, these comparisons should be judged accordingly.

A more normal comparison is given in table 11 which compares the prices obtained at sales in Rotterdam on November 10 and December 1, 1960. At the November sale, Mexican "Lisas" sold at substantial discount to Spanish Navels. At the December 1 sale, Mexican "Lisas" also sold at discount to Moroccan Navels and South African Valencias.

These comparisons would seem to indicate that, when competing fruit is of sound quality, the Mexican "Lisa" orange has

TABLE 10.--A comparison of auction prices of oranges by size, variety, and origin, Rotterdam, Netherlands, December 1956 and April 1957

Size and date	Mexican Lisas	Florida[1]	California Navels	Moroccan Navels	Cadeneras[2]
	U.S. dol. per half box[3]	*U.S. dol. per half box*[4]	*U.S. dol. per ctn.*[5]	*U.S. dol. per box*[6]	*U.S. dol. per box*[7]
December 19, 1956:					
75	3.15				
88-96	3.35		3.48	4.73	
108-110	3.68	3.08	3.81		
112				4.92	
126	3.94	3.15	4.00	5.58	5.58
144		3.22	4.20		
150				6.04	6.04
162	4.20				
172			4.46		
176				6.69	6.24
200				6.96	6.50
216				7.02	
252				7.35	
288				7.42	6.96
324				7.55	
	Valencias				Blood Ovals
April 10, 1957:	*80-lb. boxes*		*38-lb. ctns.*		*75-84 lb. boxes*
144			3.28		
172			3.68		
176	5.97				
200	6.43				
216	6.76				
252	7.35				5.58
288	7.81				5.58
324	8.01				5.58
360					5.58

[1] Variety not stated.
[2] Early seedless, non-Blood.
[3] Boxes of 80 lb.
[4] Boxes of 90 lb.
[5] 38-lb. carton.
[6] 75 to 82-lb. boxes.
[7] 75 to 86-lb. boxes.

TABLE 11.--A comparison of auction prices of oranges by size, variety, and origin, Rotterdam, Netherlands, November-December 1960

Size	November 10		December 1		
	Mexican Lisas[1] (color added)	Spanish Navels	Mexican Lisas[1]	Moroccan Navels	South African Valencias
	U.S. dol. per half box[2]	*U.S. dol. per carton*[3]	*U.S. dol. per box*[2]	*U.S. dol. per box*[4]	*U.S. dol. per box*[5]
96				4.07-5.51	3.68
126		2.76-2.08		4.40-5.51	3.68
150		2.95-3.02		4.66-5.51	
176	1.84-2.03	2.82-3.02	2.63-3.54	4.86-5.51	
200	1.84-2.03	2.89	2.63-3.54	5.25-5.65	4.20
216	1.77-2.03	3.15-3.28	2.76-3.68	5.25-5.65	3.94-4.46
224				5.25-5.51	
252	1.77-1.97	2.82-3.22	2.95-3.68	5.25-5.65	3.61-4.73
288	1.64-1.84	2.82-3.28	2.95-3.81	5.45-5.65	3.61-4.66
324	1.58-1.77		2.36-3.61	5.38-5.65	3.74-4.86
360					4.20-4.99

[1] Mixed varieties.
[2] 80-lb. boxes.
[3] 35 to 37-lb. cartons.
[4] 75 to 82-lb. boxes.
[5] 75 to 84-lb. boxes.

Source: The trade, auction catalogs.

been substantially discounted primarily because of its erratic quality. The Mexican Valencia orange, which is raised usually in irrigated groves, is certainly the most competitive orange variety that Mexico is apt to offer to either U. S., Canadian, or Western European markets.

Costs

Cultural Costs

The cash cultural cost of producing oranges in Mexico was still very reasonable in 1961. In the unirrigated, mixed-planted groves of Veracruz, the total cash cultural cost near Coatepec was estimated to range from $10.00 to $20.00 per acre per year. For the mixed-planted citrus at Fortin it was an estimated $10.00 to $15.00. These estimated are purely arbitrary, for it is not possible to separate out costs chargeable to citrus and to coffee, for example, and tobacco in a mixed planting.

In the Rio Verde Valley in the State of San Luis Potosi, the total cultural cash cost of operating an irrigated orange and tangerine grove was estimated at about $25.00 per acre per year.

In the State of Nuevo Leon the cash cost of operating the unirrigated groves in 1961 was estimated to range from $5.00 to $15.00 per acre per year. In some of these groves, tractor cultivation to control weeks is the only cultural care given. In a few of the groves, some pest control and fertilization may be carried on. Most are operated with little or no cultural care at very low cost. The cost of cultural care of irrigated orange groves in this State will vary in accordance with the water supply. Some growers estimated the cash cost of grove operation at 1,000 pesos per hectare (about $33.00 per acre). Considering the various cost factors, the total estimated cash cultural costs ranging from $45.00 to $55.00 per acre per year are representative of a grove cultivated by

TABLE 12.--Some items of production costs, Mexico, 1961

Item	Unit	F.o.b. terms	Pesos	U.S. dol.
Field labor	Per day	Jalapa, Veracruz	10.50-15.00	0.84-1.20
	...do...	Fortin, Veracruz	7-8	.56-.64
	...do...	San Luis Potosi	7	.56
	...do...	Nuevo Leon	10-12	.80-.96
Fertilizers:				
Sulfate of ammonia	Metric ton	San Luis Potosi	733	--
	Short ton	.....do.....	--	53.20
Urea	Metric ton	Montemorelos	2,000	--
	Short ton	.....do.....	--	145.15
Ammonia nitrate	Metric ton	.....do.....	1,375	--
	Short ton	.....do.....	--	99.79
Triple superphosphate	Metric ton	.....do.....	1,325	--
	Short ton	.....do.....	--	96.16
Pest control materials:				
Sulfur, dusting	Metric ton	Mexico City	680	--
	Short ton	.....do.....	--	49.35
Sulfur, wettable	Kilo	.....do.....	5	--
	Pound	.....do.....	--	.18
Spray oil	Liter	.....do.....	1.90-2.10	--
	Gallon	.....do.....	--	.58-.64
Malathion	Metric ton	.....do.....	2,900	--
	Short ton	.....do.....	--	210.47
Nursery trees, budded	Each.	Nuevo Leon	3-5	.24-.40
Cultural cost, total	Hectare	.....do.....	1,000	--
	Acre	.....do.....	--	32.38
	Hectare	Fortin, Veracruz	300-450	--
	Acre	.....do.....	--	9.71-14.57
Citrus groves	Hectare	Jalapa, Veracruz	15,000	--
(interplanted with coffee)	Acre	.....do.....	--	485.63

Source: The trade.

TABLE 13.--Estimated cash cultural costs, irrigated orange groves, Nuevo Leon, 1961

Item	U.S. dol. per acre	Item	U.S. dol. per acre
Cultivation	20	Taxes	nominal
Irrigation (labor and water)	10-15	Other	5
Pest control (material and labor)	5-10		
Fertilization	5	Total	45-55

Source: The trade.

tractor, fertilized each year, having commercial pest control, and irrigated with gravity or pump water or both. These cost estimates are higher than some, but they are an attempt to show the cost of operating a grove which would produce clean fruit of export grade. Irrigated groves in eastern Mexico, capable of producing export-quality oranges, can be operated at cash cost within the limits indicated.

In 1961, few growers were spending as much as $50.00 per acre per year in the care of citrus, since fruit at this time was being sold in a strong domestic market. There was little incentive to produce fruit which might have to meet competition in world markets.

Wages.--Mexico's low wage scale is the most significant factor in the cost structure. In 1961, in the major citrus producing areas visited, the wages of field labor varied from 56 cents to $1.20 per day. The lower wage rates are usually paid in interior areas and the higher ones in areas near the U.S. border and where there are other crops competing for labor, such as coffee and winter vegetables. In 1951 the wages of field labor varied from 69 cents to $1.04 per day in the State of Nuevo Leon and from 58 cents to 69 cents per day in the State of Veracruz.

The past 10 years has seen, therefore, little change in Mexico's rural wage rate, in terms of dollar values. However, the basic economy of Mexico is undergoing many changes. The construction of new highways, better communications, and transport is making all areas readily available to travel and trade. The completion of dams and hydro-electric power systems is bringing new areas under irrigation and furnishing power for industry.

Also, Mexico is changing its diet. In the past 10 years the wheat industry has expanded and the use of white bread is widespread; loaves of sliced bread, similar to those sold in the United States, are now available in most areas. This shift away from corn products also indicates a change from a rural self-sufficient economy to more of a money economy.

Another indication of change is the explosive growth of the poultry industry. Throughout Mexico, poultry is being raised in modern plants for eggs and for broilers. This new industry indicates a trend in the times.

As these forces bring about changes, the next 10 years will surely see a change in the rural wage rate. However, higher wage costs will create a spendable income which will make possible a wider market for citrus and citrus products. It is probable that Mexico will consume practically all of its growing citrus production.

Taxes.--In the past 10 years, there has also been little change in the taxes on citrus land. In 1951, citrus growers reported that taxes on irrigated groves were about 23 cents to 28 cents per acre per year. Interviews with growers in 1961 indicated that taxes were still nominal, usually averaging less than a dollar per acre per year even on irrigated citrus property. The low land taxes make it possible to raise citrus on unirrigated land for the return of an occasional crop. Land taxes offer no incentive for intensive production.

In addition to the nominal land taxes, agricultural produce is subject to a production tax which amounts to about 5 percent of the cash value of the crop. In the past, many growers have in one way or another avoided paying this tax, but in the future it is likely that it will be collected more rigorously. The labor laws of Mexico place an obligation upon agriculture since employees obtain permanent status after a period of employment. After obtaining status they may not be discharged without remuneration for their seniority. The discharge of a long-term employee may involve the payment of an additional year's wages or more.

The tax burden of Mexican citrus growers is still nominal, even when all taxes are paid.

Irrigation.--Cost of water for irrigation is an important factor since most areas where export-quality oranges will be produced are those where irrigation is necessary. The cost of water is subject to very wide variations. Perhaps, the least expensive is that reported in the Rio Verde Valley of San Luis Potosi--an estimated $1.00 per acre per year for gravity water. In Nuevo Leon near Montemorelos, gravity water costs about $5.00 per acre per year. The construction of new dams and a distribution system in this State will expand the area where gravity water is available. In other areas, irrigation water has to be obtained by pumping from a water table which averages about 25 feet in depth. Wells for this purpose are said to be drilled 100 feet; electric power is used to drive the pumps. Good wells throw a "head" of about 8 inches of water. In some areas, the water table in the vicinity of new wells seems to be quickly exhausted by the apparent shifting of the underground water supplies. This has resulted in the necessity to drill many wells in order to irrigate some properties. Where irrigation water has to be obtained by pumping the cost is much higher than gravity water, probably averaging $15.00 per acre per year.

In compiling an estimate of the cash cultural cost of operating orange groves in Nuevo Leon in 1961, a cost factor for irrigation water and labor of $10.00 to $15.00 per acre per year has been used. Probably this slightly understates the most expensive and it certainly overstates the cost of irrigating groves with gravity water.

Cost Per Box.--Using the cash cultural costs and yields outlined above, the cash cost of producing oranges in Mexico, per 70-pound box, was estimated to have ranged from 20 to 37 cents in Nuevo Leon, 16 to 17 cents in Veracruz, and 13 to 25 cents in the Rio Verde Valley (table 15). Since larger expenditures in cultural care usually result in a higher production of fruit, these per-box costs have been calculated by dividing the high cultural cost by high yield and the low cultural cost by low yield.

These cash cultural costs have been estimated at very moderate yields. They are indicative of the competitiveness of Mexico's orange industry. In 1961, export-grade oranges could be produced in eastern Mexico in practically all irrigated groves for a cash cost of less than 40 cents per 70-pound box.

Marketing Costs

In evaluating the potential of Mexico's citrus industry as an exporter, marketing costs are much more critical than cultural costs. The cost of picking oranges and hauling them to Mexico City is greater than the cost of producing the fruit in all districts, and in remote areas it is double the cultural cost. The marketing cost is less than the cash cost of production only for that fruit sold in the immediate area of production.

Picking.--In 1961 the cost of picking oranges in Nuevo Leon was estimated at 1 peso per 90-pound box (about $.06 per 70-pound box). In the State of Veracruz and in the Rio Verde Valley it was estimated at 5 cents per box. The cost of picking tangerines was estimated higher, at 9 cents per 70-pound box. Practically all costs of picking include cartage to an in-grove road or to roadside. The unit picking cost was low, but a picker would have to harvest only 20 boxes per day to earn a wage equal to that of field labor (table 15).

Domestic Transport.--In Mexico's domestic market, the cost of cartage from the grove to market is a major marketing expense. According to trade estimates, it costs about 48 cents to haul a 70-pound box of fruit from Nuevo Leon to Mexico City, the most important domestic market, 20 to 30 cents from Veracruz, and about 32 cents per box from the Rio Verde Valley. (Practically all of this domestic fruit is shipped in bulk and it is recorded here in 70-pound box equivalents for purposes of comparison.) Cost of transport varies widely since truckers often purchase fruit in the producing area, haul it to Mexico City, and sell it there. The cost of transport is therefore intermingled with the profit that might be made on such a transaction. Truckers also attempt to find freight loads for the return journey. The closest major citrus area to Mexico City is that of Veracruz; even here, the estimated cost of hauling fruit to market is higher than the estimated cultural cost.

The transport of fruit from producing area to domestic market involves costs other than that of cartage. These include a production tax which usually amounts to about 5 percent of the value of the fruit. In addition, trucks hauling citrus to market are usually subject to intransit fees or taxes which are collected casually on the road. These taxes and intransit fees may be estimated to average about 10 cents per 70-pound box, making the estimated cost of moving citrus from producing areas to market about 58 cents per 70-pound box from Nuevo Leon, 30 to 40 cents from Veracruz, and about 42 cents from Rio Verde.

Break-Even Costs in Mexico City[7].--The 1961 cash cost of raising oranges and delivering them to Mexico City is estimated to range from 74 cents to 91 cents per 70-pound box for fruit from Nuevo Leon, 42 cents to 51 cents per box for Veracruz oranges, and 40 cents to 62 cents per box for oranges from the Rio Verde Valley. These break-even costs are an evaluation of the competitive potential of the Mexican orange industry. They indicate the cost of raising fruit and transporting it to market.

In 1961, on a break-even basis, good-quality ungraded fruit from irrigated groves in Nuevo Leon could be delivered to Mexico City for less than $1.00 a box; this figure includes a probable production tax and the fees collected in transit. On the same basis, Veracruz growers could deliver their low-grade tropical fruit to Mexico City for less than 65 cents per 70-pound box, and Rio Verde growers could deliver their fruit for 75 cents per box, all cartage fees included.

Exporting.--Exporting citrus from Mexico involves special expenditures. Packinghouses must be equipped to wash, size, grade, and pack export fruit. All export packinghouses serving U. S. markets must be equipped with gas sterilization chambers built in accordance with U. S. Department of Agriculture specifications. In 1961, 23 export packinghouses had such equipment. Twenty of them were located in the State of Nuevo Leon, one in the State of Tamaulipas, and one in the Rio Verde Valley of San Luis Potosi (table 23).

While packing plants are occasionally used to wash and size fruit for the domestic market, their primary use is for export fruit.

The 23 export-equipped packinghouses probably have a capacity of 1 million 1-2/5-bushel boxes of oranges per month. In 1960, Mexico exported a total of about 750,000 boxes, and the packing of these oranges probably utilized not more than 20 percent of Mexico's export packing capacity. The cost of exports therefore has included the building and maintenance of a packing capacity far beyond immediate needs. The major costs of exporting in Mexico involve buildings and equipment, packing materials, transport, fees, and taxes.

Wages are the smallest item of export expense. Packing is on a piece rate, and in 1961, in eastern Mexico women were paid about

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[7] Untreated fruit. Fruit washed, waxed, and sized would cost 10 to 15 cents per box more.

20 centavos (about $0.02) for packing a 1-2/5-bushel export full-wrap pack. The wages of men engaged in general citrus packinghouse work was reported to range from about 96 cents to $1.20 per day.

In the past 10 years the Mexican peso has been revalued but there has been little change in the cost of export packing in terms of dollar value. In 1951, women packers were reported to have been receiving approximately 3 cents per box, and men working in packinghouses were paid from 69 cents to $1.39 cents per day. The cost of picking export fruit was estimated at 4 cents per box and the total cash cost of picking and packing at 94 cents per box.[8]

Trade sources in Nuevo Leon estimated that in 1961 the cost of a 1-2/5-bushel box was 57 cents, the cost of packing 15 cents, making the total cost of packing a box of oranges 72 cents. The transport from Montemorelos to the U. S. Border was about 32 cents per box and the Mexican fees and expenses at the border about 41 cents per box. Thus, the border fees and the transport from the packinghouse exceeded the cost of the box and packing.

The estimated cost of delivering a packed box of Nuevo Leon oranges to the U. S. border was $1.45 in 1961, and the cost of delivering a packed box of fruit to the United States, U. S. duty paid, was estimated at $2.25.

At these costs, exporters could pay Mexican growers $2.00 per 70-pound box of fruit, deliver it at the U. S. border, U. S. duty paid, for $5.00 per 1-2/5-bushel box, and make a profit of nearly 70 cents per box.

Break-Even Costs at U. S. Border.--When production, picking, and packing costs are added to marketing costs, oranges from the State of Nuevo Leon in 1961 could be delivered at the U. S. border in full-wrap packed 1-2/5-bushel boxes for less than $2.00 per

TABLE 14.--Oranges: Estimated packing and exporting costs, Nuevo Leon, 1961

Item	Per 1-2/5 bu. box		Per 1/2 Bruce box	
	Pesos	*U.S. dol.*	*Pesos*	*U.S. dol.*
Shook	6.00	0.48	3.50	0.28
Nails and label	1.00	.08	.50	.04
Labor	.12	.01	.06	(1)
Total cost of box	7.12	.57	4.06	.32
Packing labor	.20	.02	.10	.01
Packinghouse overhead	1.00	.08	.50	.04
USDA inspection	.62	.05	.40	.03
Total cost of packing	1.82	.15	1.00	.08
Total box and packing	8.94	.72	5.06	.40
Truck to border	4.00	.32	2.00	.16
Mexican export tax	2.00	.16	1.00	.08
Bridge toll and broker fees	1.88	.15	.875	.07
Selling commission	1.25	.10	.625	.05
Cost of export at U.S. border	18.07	1.45	9.56	.76
U.S. duty	--	.80	--	.40
Total		2.25		1.16

(1) Less than 1 cent.

Source: The trade.

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[8] "Changes in Mexico's Citrus Industry, Foreign Agriculture Report No. 70, pp. 123-124.

TABLE 15.--Estimated break-even cost for oranges, Mexico, 1961

Item	Unit	Producing area			
		Nuevo Leon		Veracruz	Rio Verde San Luis Potosi
		Irrigated	Unirrigated	Unirrigated mixed planted	Irrigated
Cash cultural cost..........	Dol. per acre	45-55	5-15	10-20	25
Yield of oranges[1]...........	70-lb. boxes per acre	120-250	25-75	60-125	100-200
Cost[2]................	Dol. per 70-lb. box	.37-.22	.20-.20	.17-.16	.25-.13
Cost of picking............	Dol. per 70-lb. box	.06-.06	.06-.06	.05-.05	.05-.05
Total..................	Dol. per 70-lb. box	.43-.28	.26-.26	.22-.21	.30-.18
Hauling to Mexico City[3].....	Dol. per 70-lb. box	.48-.48	.48-.48	.20-.30	.32-.32
Cost of exporting[4]..........	Dol. per 1-2/5 bu. box	1.45-1.45	1.45-1.45	--	[5]1.75-[5]1.75
Break-even cost:					
In Mexico City............	Dol. per 70-lb. box	.91-.76	.74-.74	.42-.51	.62-.40
At U.S. border............	Dol. per 1-2/5 bu. box	1.88-1.73	1.71-1.71	--	2.05-1.93
At U.S. border U.S. duty-paid...........	Dol. per 1-2/5 bu. box	2.68-2.53	2.51-2.51	--	2.85-2.73

[1] Valencias, "Lisas", seedlings.
[2] Calculated by dividing high cost by high yield and low cost by low yield.
[3] Bulk, metric ton, rates converted to box unit for comparison.
[4] Table 14.
[5] Nuevo Leon packing costs plus an estimated 62 cents per box to cover hauling from Rio Verde to U.S. border.

box. Oranges from Nuevo Leon could be delivered at the U. S. border with the U. S. duty paid for an estimated break-even cash cost of less than $2.75 per 1-2/5-bushel box.

It is unlikely that any fruit will ever be delivered to the border at such prices, but this serves to illustrate the level of costs in the Mexican citrus industry and its potential as a competitor.

Export vs. Domestic Sale.--For the Mexican fruit trader, the deciding factor as to where purchased fruit will be sold--whether at home or abroad--is usually marketing costs. As an example, in April 1960 when a fruit trader paid 800 pesos per metric ton (about $2.00 per 70-lb. box) for oranges, he could deliver them in the Mexico City market for about $2.54 per box. In April, the Mexico City market was paying about 18 cents per dozen for fancy oranges, or about $3.60 per box containing 20 dozen fruit. At this cost and price, fruit traders would have a profit of about $1.00 per box. By comparison, if the fruit buyer paid $2.00 per box for Valencias on the tree and decided to export, the cost of export picking, packing, and border costs, including U. S. duty, would be $2.31 per box. This fruit would have to be sold at the U. S. border, U. S. duty paid, for about $5.31 per box in order to return the same profit that could be obtained in the Mexico City market.

As long as the Mexican domestic orange market remains strong, paying good prices, export marketing will be attractive to the Mexican fruit trader only when world markets are sufficiently stable and high to cover the additional cost and the risk of exports.

Returns to Growers

In recent years, citrus growing has been a profitable enterprise in Mexico. Most growers have made good returns.

In the State of Nuevo Leon growers report that in the 1960-61 season, "Lisa" oranges were sold for about 400 pesos per metric ton ($1.00 per 70-lb. box) on the tree. Valencias were easily sold at $2.00 per box on the tree, and late in the season some brought $3.00 per box. This was largely fairly clean, well-colored fruit.

In the State of Veracruz shade-grown seedling oranges were reported to have been sold for prices of from 80 cents to 97 cents per 70-pound box, and shade-grown Valencia oranges for $1.62 to $2.03 per box on the tree. These would seem to be high prices for insect and diseased, disfigured juice oranges. Veracruz growers selling fruit to processors are reported to have received about 75 cents per 70-pound box.

The net returns to growers over cash costs may be roughly calculated by comparing these returns to the yield and costs in table 15. In the State of Nuevo Leon irrigated groves with a yield of 120 boxes per acre would receive a net profit over cash costs of $75.00 per acre for groves having a cash cultural cost of $45.00. Irrigated groves with the highest cost and yield would return a profit over cash costs of $195.00 per acre, at this cost. The grower producing "Lisa" oranges on unirrigated land made $20.00 per acre on a yield of 25 boxes, possibly $60.00 per acre on a yield of 75 boxes. Nuevo Leon growers with a yield of 250 boxes of Valencias per acre had a gross return of about $500.00 at $2.00 per box which returned a net profit above cash costs of about $440.00 per acre. Those growers lucky enough to sell Valencias for $3.00 per box received a correspondingly higher return.

In the State of Veracruz citrus growers who raised a shade-grown fruit interplanted with coffee received a net return of $38.00 per acre when the fruit was 81 cents per box and the yield 60 boxes per acre. At the same price growers having a yield of 125 boxes per acre returned a cash profit of about $81.00 per acre. In this district, coffee is considered to be the main crop and, therefore, these would seem to be good returns for a crop of secondary importance.

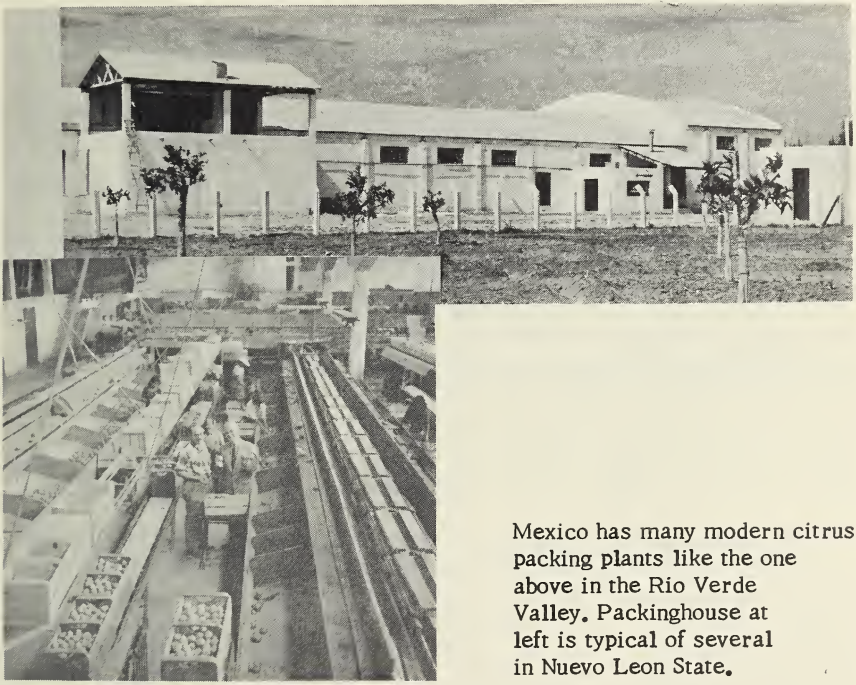
PROCESSING

In the past 10 years, Mexico has nearly doubled its processing capacity. In 1961, the total processing capacity of oranges and limes was probably sufficient to use 600 to 800 short tons of fruit per day. Considering the length of the processing season, this is a capacity sufficient to use 10 to 15 percent of production. In 1961, only a small part of processing capacity was used and the processing of limes was at a low ebb for lack of a market for essential oil and juice. The processing capacity for oranges was also above that of the immediate needs of the market.

The trade estimates that, in 1961, processors used about 1 million to $1\frac{1}{2}$ million 70-pound boxes of oranges, or about 5 to 7 percent of the total Mexican production. The use of limes for products is estimated between one-half and three-quarters of a million 70-pound boxes of fruit. This is nearly one-third of the lime production and the rate of processing, at least partly, illustrates a utilization to dispose of a surplus. About 2 percent or less than 10,000 boxes of grapefruit are used for products in Mexico.

Processors have a mixed cost situation. Wages are reasonable, with ordinary plant labor being paid $1.00 to $1.50 per day, and semiskilled labor perhaps double that. The cost of fruit in the 1960-61 season was fairly moderate, ranging from about $23.00 to $30.00 per short ton for early and midseason oranges to as high as $36.00 to $44.00 for late-season Valencia fruit. This cost structure indicates that the usual processing season in Mexico is going to be short, since very small quantities of the higher priced late fruit will be used. Taxes on equipment and plant are said to be low, but the cost of repairs and maintenance is probably high by our standards. Also, Mexican processors have to maintain auxiliary electric generating capacity to supplement normal sources. Mexican processors probably pay higher prices for cans for packing juice than do processors in the United States. In 1961, processors quoted No. 2 cans with lids at 6 cents each, No. 10 at 16 cents each, and 1 gallon cans at 22 cents each, f.o.b., processing plants.

Processors of oranges in Nuevo Leon face different problems than do processors in Veracruz. In Veracruz, fruit is slightly earlier and, while the season begins in early November, it also ends before the first of April. In Nuevo Leon the season begins at the end of November but continues on to the middle of May. There is a significant difference in fruit quality between the areas, and the Brix of juice from Veracruz seems to vary from about 11° at the beginning of the season to about 13.5° by the end of March.



Mexico has many modern citrus packing plants like the one above in the Rio Verde Valley. Packinghouse at left is typical of several in Nuevo Leon State.

TABLE 16.--Orange juice from Nuevo Leon and Veracruz compared, 1959-60

Nuevo Leon			Veracruz		
Date	Brix	Sugar acid	Date	Brix	Sugar acid
1959	Degrees	Ratio	1959	Degrees	Ratio
November 29[1]	12.00	10.84 to 1	November 4[3]	10.9	7.32 to 1
December 6	12.12	12.17	....do..12	11.1	7.40
....do...13	12.35	12.10	....do..21	11.0	7.38
....do...20	13.17	12.17	....do..30	11.8	8.43
			December 7	11.6	8.23
1960			....do..14	11.4	8.03
January 3	13.49	13.01	....do..21	12.0	8.96
....do..10	13.68	13.69			
....do..17	13.83	13.38	1960		
....do..24	13.78	13.67	January 2	12.1	8.90
....do..31	14.04	14.10	....do.10	12.4	9.05
February 7	14.54	14.95	....do.17	12.4	9.92
....do..14	14.88	15.87	....do.23	12.4	10.42
....do..21	15.04	15.50	....do.30	12.5	8.33
February 28[2]	13.46	10.25	February 6	12.8	10.58
March 6	13.28	13.16	....do..14	12.8	10.67
....do..13	13.93	12.55	....do..21	12.9	10.93
....do..20	13.73	13.50	....do..27	12.7	10.67
....do..27	14.31	15.68	March 5	13.6	11.33
April 3	14.42	14.72	....do..12	13.3	12.67
....do..10	13.74	14.68	....do..18	13.9	11.88
....do..17	14.21	15.02	....do..22	13.6	11.83
....do..24	13.72	16.25			
May 1	14.01	16.60			
....do..8	14.06	17.22			

[1] November 29 to February 21 "Lisa," mixed early varieties.
[2] Beginning of Valencia season.
[3] All "corriente" seeded oranges, November 4 to March 22.

Source: The trade.

By comparison, the Brix of oranges from Nuevo Leon start at about 12° and at the end of the season the Valencia fruit tested indicates average value over 14°.

The characteristics of Mexican distilled and cold pressed lime oil, the other major processed product, are illustrated in the following ranges of value:

Specific weight, at "15 degrees centigrade--over 15 degrees centigrade," ranges from 0.862 to 0.868 and not less than 0.864

Optical rotation is +30° +46°30'

Refraction index at 20° is 1.4750 to 1.4770

Estimated aldehyde content is 0.5 to 1.5 percent

The average citral content is 1.0 percent.

Prices

The prices of orange products have been influenced by the domestic market situation and the price of lime products, mostly by the export market for essential oil of lime. The Mexican soft drink industry is the major customer for all industrial orange juices produced. This is not a free market since the retail price of citrus-flavored soft drinks is regulated by the government. The use of soft drinks leads them to be considered an item of general diet and in the category of a food. Because of the fixed price on citrus-flavored soft drinks the value of orange juice concentrate for the soft drink industry in Mexico is about $2.50 per U. S. gallon. As the value of juice in the domestic market is regulated, processors are seeking export outlets where juice may be disposed of at higher values.

Trade sources in 1961 stated that 65° Brix hot-pack orange juice concentrate was being quoted at $2.75 to $3.75 per U. S. gallon, c.i.f., the border, depending upon the size of container. Frozen orange juice concentrate of 62° Brix was quoted at $3.20 per U. S. gallon, c.i.f., the Mexican border. Most of the frozen concentrate was packed in 50-gallon drums. Essential oil of orange was quoted by the trade at $1.45 to $1.50 per pound, f.o.b., Mexico City. Dried peel for cattle feed is one item which is uncontrolled in price and, in 1961, processors were quoting this item at about $22.00 to $28.00 per short ton, f.o.b., processing plant, packed in either paper or cloth bags.

Government Regulation

In the past 10 years, changes in government regulation have affected the orange and lime processing industries differently. The orange processing industry is subject only to the normal regulations of doing business in Mexico. These are confined primarily to labor laws and the retention of long-term employees and, in marketing, to the fixed prices on soft drinks. These are minor regulations compared with those in force in the lime industry.

In the last decade the increased plantings of limes resulted in a surplus and a market glut for lime oil and lime juice. The situation is further complicated by the fact that a part of this processing is done by semi-government-controlled plants which by law are forced to accept certain quantities of fruit, and, therefore, to act as surplus disposal agencies. As a result of this situation the government established the National Union of Lime Oil Producers. This quasi-governmental organization has been formed as a regulatory agency of the Mexican lime industry. Its Board of Directors includes representatives of the Ministry of Agriculture, the Ministry of Finance, the Ministry of Industry and Commerce, and the Bank of Mexico.

The Union regulates plantings, establishes quality specifications of lime oil and juice, and, in issuing all export permits for lime oil, certifies that the exported product conforms to the Union's quality standards.

In exercising its control, the Union has decreed a limitation on lime plantings in order that the production might conform to the domestic market needs and the requirements of the lime processing plants.

The national production of essential oil of lime from 1955 to 1959 is estimated as follows:

	1,000 lb.
1955	187
1956	265
1957	386
1958	573
1959	346

The Union establishes a yearly quota on the quantity of lime oil, both distilled and cold-pressed, which may be produced. In

December of each year the Union surveys the market situation and estimates the quantity of oil which it will be possible to use in the domestic market and to supply exports. Based on this estimate, quotas are given to each lime oil producer and such quotas of production will be equal to the quantity required by the consuming market plus an extra 10 percent.

The Union also claims to be active in developing new products, seeking new markets, and developing new methods of sale for both juice and oil.

In the last 9 years the lime industry has undergone a change, in that both concentrated lime juice and lime juice powder are now commercial products. The Union has taken action which will result in the use of all the waste residue from operating lime processing plants for the production of citric acid. It is estimated that Mexico now uses about 2,600 metric tons of citric acid each year.

In 1961, Mexico had about 40 lime processing plants. Most are small installations and only 2, one at Llera and one at Apatzingan, now produce lime juice for export. The plant at Llera has facilities for producing and storing frozen lime juice. In addition, the large processing plant in Veracruz is capable of producing export-quality juice.

Most lime plants are near Colima and Apatzingan; however, there are 2 in the State of Veracruz and 4 near Acapulco.

Inspection of plants is a part of the quality control activity. In January 1961, 7 processing plants were reported to be closed due to their inability to meet the Union's standards.

Since 1958, concentrated lime juice exports to the United Kingdom for use in England's squash industry have averaged 70,000 gallons per year. This juice contains 29.6 percent anhydrous citric acid per 100 grams of juice. The juice is shipped to England in waxed and polyethylene-lined wooden casks. It is preserved with 1 part of sulfur dioxide per thousand.

In 1961 the concentrated lime juice was quoted at $2.90 to $3.10 per imperial gallon, f.o.b., the Mexican border. Distilled lime oil was quoted at $5.00 per lb. and cold-pressed lime oil at $6.70 per lb. f.o.b., the Mexican border.

The Union has developed a lime juice powder which will be sold in Mexico and may also be offered for export in a plastic green lime.

The Union is a controversial organization. It maintains that its activities are necessary in order to bring stability to a chaotic situation. It claims its efforts are to improve the markets for lime oil and the quality of Mexican lime products. In opposition, some private processors maintain that the Union interferes with the marketing of lime products. These private processors point out that the Union is a lime product monopoly in Mexico. When a quotation is received for lime products the Union supplies samples, the buyer must make a selection from the samples supplied, and the product is then shipped by the Union. A buyer may not purchase oil from any selected plant in Mexico.

The future of the Union is still to be decided but the Mexican lime industry will continue to face problems as long as the very large stocks of surplus oil exist. In 1961, it was observed that none of the private lime processing plants visited were operating, and many have not operated for over a year.

Nuevo Leon

Mexico has a growing market for citrus juices, and most processing plants produce orange juice concentrate for this market. Some of it is hot-pack but most of it is preserved with SO_2. There is one small processing plant near Monterrey which utilizes about 60 metric tons (44 short tons) of citrus per day. This small plant produces hot-pack orange juice concentrate for a soft-drink bottling firm for sale in Mexico.

Near the town of Montemorelos a new plant started operating late in the season of 1959 to produce frozen orange juice concentrate for export. Its maximum capacity is estimated at 130 short tons of fruit per day.

This plant has large scales for weighing fruit as it is received by truck. It also has large modern fruit storage bins. Fruit drawn from these bins for processing passes over a grading table where rotten fruit is discarded. Fruit is washed prior to going to the four high-speed modern juice extractors, and the juice is screened before going to the concentrating pans. The frozen orange juice concentrate is packed in polyethylene-lined 55-gallon steel drums. A large cold storage room is available for storing the juice pending export. A well-equipped laboratory is maintained to analyze each load of fruit as it is received, and to perform quality control. A U. S. Department of Agriculture representative is in attendance, making tests to establish grade standards during the processing season.

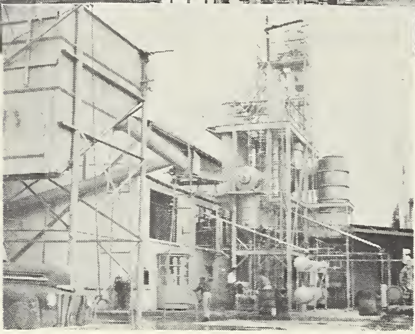
The plant has its own well water and generates its own electric power. To its frozen juice concentrate production, the plant added essential oil of orange in 1960-61 season. Recently two dehydrating drums have been installed. The dried peel is packed in paper bags for marketing in the northern cattle State of Mexico, where cattle are fed for export to the United States. While this dried peel is now sold entirely in Mexico it has been approved for marketing in the United States.

The plant has buyers who arrange for the purchase of fruit and its delivery schedule. It is paid for as delivered by truck to the processing plant. In January 1961, 400 pesos per metric ton ($29.00 per short ton) was being paid for early "Lisa" oranges delivered at the plant. (This "Lisa" orange is a group of early and midseason varieties.) Since the fruit is received from all types of groves, some of which are unirrigated, it is of varying size and maturity.

The juice observed in January 1961 made from the early "Lisa" oranges had good color. The juice which is made later in the season from Valencia oranges is reported to be even higher in color.

When the juice is exported to the United States it is sent to Brownsville, Texas, by refrigerated motor truck. It may be transported from the border to its destination in the United States either by refrigerated truck or rail cars capable of handling the frozen food.

Such of this juice as is re-exported may be subject to a rebate of the U. S. duty.



Large processing plant, Irapuato, State of Guanajuato, produces frozen orange juice concentrate and other food products. Left, a concentrating "pan," Nuevo Leon.

Veracruz

Veracruz is one of the most important centers of processing in Mexico, producing orange, lime, and grapefruit products. The largest plant in Veracruz and one of the largest in Mexico is located at Coatepec in the heart of the coffee area, which is mostly interplanted with seedling citrus.

This modern plant with a capacity of at least 275 short tons of fruit per day produces at times small quantities of canned single-strength juice, but its primary production is industrial items, including canned hot-pack and preserved 65° Brix orange juice concentrate, essential oil of orange and lime, and dried peel for cattle feed. The plant is well located from the point of view of supplies of fruit since there is an abundance of processing-type oranges in the immediate vicinity. The shade-grown oranges in this area are not selling well as fresh fruit because of the growing preference of Mexican markets for the cleaner northern citrus. Thus, it is likely that increasing quantities of citrus will be available for processing.

The primary processing season is from November through March, and in the 1960-61 season the average prices for processing oranges paid at the plant were said to be about $23.00 per short ton.

Juice yields are said to average for oranges about 91 to 95 U. S. gallons per short ton of fruit. The ascorbic acid content of single-strength orange juice is said to average 72 milligrams per centiliter of juice and about 410 milligrams per hundred centiliters of 65° Brix orange juice concentrate.

Processors in Veracruz face the usual difficulties of having to provide auxiliary electric generating power. In addition, it is always a problem to obtain technical employees for the operation of a modern plant. Fruit supplies are also a problem when frequent rains interrupt picking. The flow of supplies to the plant may also be interrupted when the harvest of coffee uses most available labor.

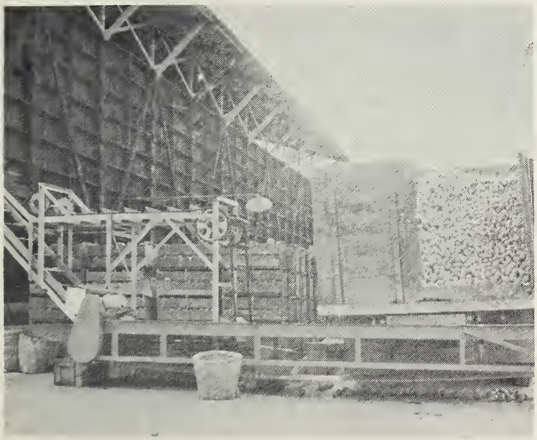
One Veracruz processor has packed a small quantity of canned single-strength juice to be used in a local school lunch program. There is some interest being expressed in this project and it is a possibility that the use of citrus juices might become a part of a Mexican school lunch program.

There are several processing installations in the coastal plains of Veracruz. These are mostly small installations, some producing essential oil of lime and small quantities of lime juice, and some single-strength grapefruit juice each year for the domestic Mexican market. The pineapple processors are located reasonably near some of the best grapefruit producing areas in Mexico.

In the future, Veracruz may be expected to become more important as a center of processing in Mexico. The major products will probably be industrial orange juice concentrate and essential oils.

Mexico City

While most of the citrus processing in Mexico is carried out in the areas of production, there is some processing in areas far removed from citrus sources. One of these is Mexico City where small quantities of grapefruit juice and orange juice are canned. The plants doing this processing are general food processing and canning plants, and citrus is only a minor item of their total operation. The general differentiation in this type of processing is between the type of product. Processing in Mexico City is concerned entirely with the production of a canned single-strength juice for sale directly to the consumer. Processing in citrus areas is primary to produce industrial citrus products.



Fruit delivered at modern processing plant in Nuevo Leon moves into tiers of storage bins along the back.

Guanajuato

A modern processing plant has been established in this State at the city of Irapuato. It is a multipurpose frozen-food installation, whose main product is frozen strawberries. Its capacity is said to be 140 to 160 metric tons of fruit per day, and it was operating at full capacity when observed in January of 1961.

Oranges for processing have to be hauled for long distances. Most of them come from two States--Nuevo Leon, near Montemorelos, and Veracruz, near Jalapa and Cordova. Many different types of fruit are, therefore, received at the plant. The oranges from Veracruz, mostly grown interplanted with coffee, are thin-skinned, green-peeled seedlings. They have a high juice yield and high acidity and are usually somewhat low in solids. In contrast, the oranges from the State of Nuevo Leon are highly colored and have a good solid yield.

As each truckload or freight car of fruit is received, samples are taken to a laboratory where they are analyzed for juice yield, Brix, and the sugar acid ratio. Meantime, the fruit is being graded as to maturity and is then stored separately in large fruit-holding bins. When the bins are emptied oranges are re-sorted in order to remove damaged fruit. The fruit is then washed and the juice extracted on four high-speed U. S. manufactured juice extractors. After passing through a finisher, the juice is concentrated by one of two methods. About two-thirds of the juice produced is concentrated in low-temperature continuous vacuum "pans." These high-capacity concentrators are supplemented by a concentrator which concentrates by "cold;" this is used for about one-third of the capacity of the plant. By this process the water is removed from the juice by the formation of ice crystals. These crystals are removed from the concentrate by a centrifuge. The juice concentrated by the two methods is blended into the final product.

A continuous quality control is maintained at the plant's laboratory. The processing is run in accordance with the test of the fruit being used. A constant check is made on the concentrate produced as to bacterial count, essential oil content, and other quality factors.

The concentration by "cold" process utilized in this plant is known to the author to be used in only one other foreign processing plant in the world and that is in Spain.

The facilities available for the freezing of strawberries are also available for orange juice, as are the frozen storage rooms at the plant.

In January 1961, trade sources indicate that processing oranges from Montemorelos were costing $33.00 per short ton, and oranges from the State of Veracruz $28.00. Due to the location of the plant, freight cost in the shipment of fruit from producing areas is a considerable expense. In 1961, trade sources indicate that the freight by rail from Montemorelos to Irapuato was 110 pesos per metric ton ($7.98 per short ton) and 150 pesos ($10.80 per short ton) by motor truck. The freight was cheaper from Veracruz--reported to be 90 pesos per metric ton by rail and 130 pesos per metric ton by truck.

While rail transport is cheaper, it is also slower and is apt to result in more decayed fruit; the fruit is shipped in bulk, piled 5 to 6 feet deep in ordinary, full-size unrefrigerated box cars.

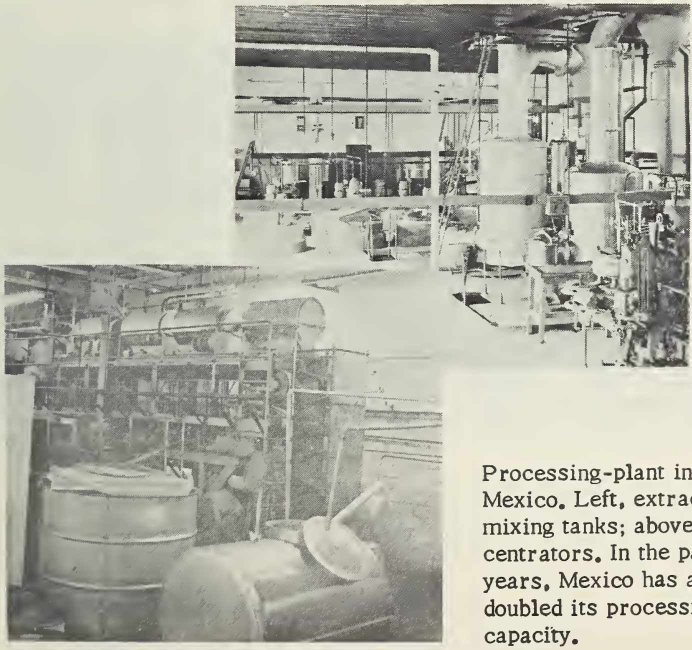
The operation of a modern processing plant in Mexico still presents many problems. One of them is trained technical labor. Another is electric power, in spite of the very great increase in the past few years. The operation of a low-vacuum orange juice concentrator demands a constant, unvarying supply of electric power. For this reason it is impossible to use the normal government-supplied electric power, and the plant operates its own electric generating plant to supply power to the concentrating "pan." High-speed diesel motors are used as generating power.

The primary product of the plant is 42° Brix frozen orange juice concentrate, which is packed in 6-ounce and 32-ounce cans and in 55-gallon polyethylene-lined drums. The plant also produces 65° Brix hot-pack orange juice concentrate, dried orange peel for cattle food, essential oil of orange, and citrus marmalade.

This organization is a pioneer in marketing frozen orange juice concentrate in Mexico. It has achieved a distribution in most of Mexico's supermarkets of frozen orange juice concentrate in the 6-ounce cans. This juice is retailed at a price of 2.75 pesos ($0.22 per can, table 8). It is reported that the company has supplied freezing cabinets to the stores. An active merchandising and advertising campaign is carried on over Mexico's television stations.

While the frozen orange juice concentrate is produced primarily for the domestic market, both the frozen juice and the 65° Brix hot-pack concentrate is exported to Canada and to Europe.

The pioneering of the marketing of frozen orange juice concentrate in Mexico by this organization is evidence of the growing importance of Mexico's domestic citrus juice market.



Processing-plant interiors, Mexico. Left, extractors and mixing tanks; above, concentrators. In the past 10 years, Mexico has almost doubled its processing capacity.

Tamaulipas

A citrus processing plant was constructed over 10 years ago at Llera by a government agency. This small plant is located near small supplies of oranges and limes and between large citrus areas of Valles, over 100 miles to the south, and Montemorelos nearly 200 miles north.

This fairly modern plant can produce canned single-strength, hot-pack and preserved juices, as well as essential oil, dried peel for cattle feed, and tomato products. It is reported to have a capacity of 2-1/2 tons of fruit per hour, about 40 tons per day; however, some of the equipment is said to have a higher capacity. The concentrator is reported to be able to use 400 U. S. gallons of juice per hour.

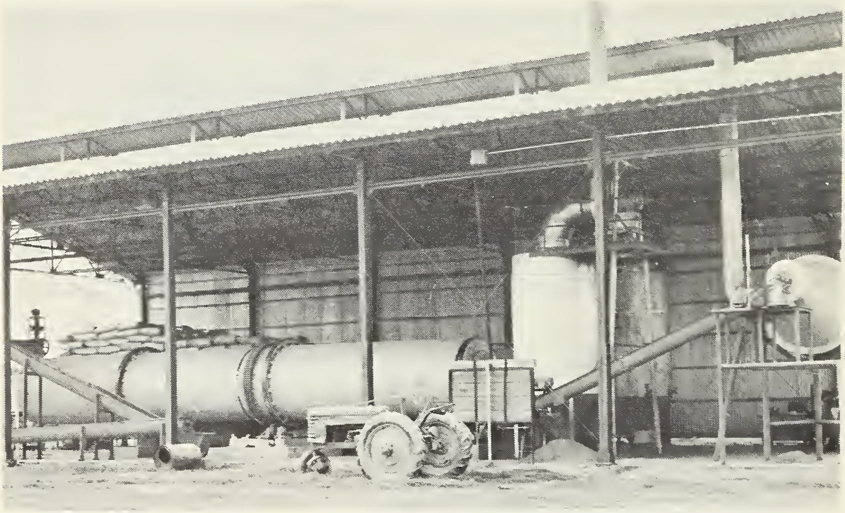
The plant has electric generating equipment and frozen storage facilities.

Processing experience indicates that the average orange juice yield is 75 to 100 U. S. gallons per short ton of fruit.

The fruit solids of oranges in this area are said to average 12 percent, and acidity does not exceed 2 percent. The average cost of oranges at the plant has been about $19.00 per short ton.

The processing of limes is reported to yield 1-1/2 kilos of cold pressed oil per metric ton, 3 pounds per short ton of fruit.

This poorly located plant is likely to be of minor future importance.



This processing plant, like several others in Mexico, dries citrus peel for cattle feed. All dried peel is now sold in Mexico, but it has been approved for marketing in the U.S.

TABLE 17.--Citrus products: Exports by kind and year, Mexico, 1950-60

Calendar year	Orange juice[1]	Lime juice[2]	Orange oil	Lime oil
	1,000 gal.	*1,000 gal.*	*1,000 lb.*	*1,000 lb.*
1950	--	--	(3)	47
1951	--	--	(3)	48
1952	--	--	(3)	291
1953	--	--	(3)	214
1954	--	--	7	276
1955	--	--	(4)	172
1956	--	--	0	281
1957	--	--	4	452
1958	229	89	1	378
1959	224	78	8	98
1960	583	22	1	143

[1] Converted as frozen concentrate 42° Brix. Not separately classified prior to 1958.
[2] Converted as concentrate 10 lb. per gal. Not separately classified prior to 1958.
[3] Not separately classified.
[4] Less than 500 lb.

Exports

In the past 10 years Mexico has become an increasingly important citrus products exporter. The sustained export item has been essential oil of lime. In the last few years, orange juice has become a substantial export item and lime juice trade has also increased.

After 1965 or 1967, when Nuevo Leon is expected to recover from freeze damage, Mexico may be expected to become a much more important source of citrus processed products. Orange juice exports, primarily those of industrial quality, may be expected to increase substantially above present levels. Lime juice exports will probably be sustained at about recent levels. The export of essential oil of orange will probably increase as orange processing expands. Since there is a limited use of essential oil of lime, it is probable that the total volume of exports will be maintained at about present levels.

The United States was by far the largest customer for orange juice in 1959 (table 6). This was primarily orange juice concentrate. Canada was the next most important country, followed by Germany, Norway, and the Netherlands, in that order. Trade with the United States will probably continue to expand after 1965 unless defects in Mexican juice restrict this trade.

Lime juice trade with England is now a substantial item; where this product is used for "lime squash." Some frozen lime juice is also exported to the United States.

The United States is also the best customer for Mexican essential oil of orange, and Canada and the Netherlands purchase most of the remaining export supplies. The United States is the big market for essential oil of lime, importing over 90,000 pounds in 1959. The United Kingdom is the next most important market, followed by the Netherlands, El Salvador, Germany, and Cuba.

In 1955 to 1960 Mexico's trade with Canada was important. The major item in this trade has been orange juice concentrate, and in 1960, 24,000 gallons of the total of 27,000 gallons of juice imported was frozen orange juice concentrate. Mexican facilities for producing frozen juice have expanded, and it is likely that juice export trade will grow in the future. There will be little or no Mexican exports of canned single-strength juice to Canada unless shortages in the United States restrict U. S. trade.

TABLE 18.--Citrus juice: Canadian imports of specified Mexican products, 1955-60

Calendar year	Oranges		Grapefruit	Blended
	Single-strength	Concentrated	Single-strength	Single-strength
	1,000 U.S. gal.	*1,000 U.S. gal.*	*1,000 U.S. gal.*	*1,000 U.S. gal.*
1955	5	10	3	4
1956	1	3	9	1
1957	--	22	--	--
1958	--	13	--	--
1959	--	26	--	--
1960	--	[1] 27	--	--

[1] Includes 23,523 gal. of frozen concentrate.

U. S. Trade With Mexico

In 1950 to 1960, Mexico was a small market for U. S. orange juice, importing about 27,000 gallons of single-strength juice in 1960, 8,000 gallons of frozen concentrate, and about 2,000 gallons of hot-pack concentrate. At the same time U. S. imports of unspecified juices (a U. S. customs classification) have been much greater. These juices are primarily frozen orange juice concentrate--an item not separately classified for U. S. import data. In 1960, the United States imported 16,000 gallons of single-strength juice in this category and nearly 2 million gallons single-strength equivalent of frozen orange juice concentrate. U. S. imports of frozen orange juice concentrate from Mexico will probably continue to expand after 1965. This juice is imported into the United States primarily in 50-gallon drums.

Mexico has been a small market for U. S. grapefruit juice, importing 23,000 gallons of single-strength juice in 1960, 3,000 of frozen concentrate, and 51,000 gallons of hot-pack grapefruit concentrate. In 1960, the United States also exported to Mexico about 4,000 gallons of blended single-strength juice. Trade in lime juice has all been imports from Mexico, which totaled 24,000 gallons of single-strength lime juice in 1960 and 31,000 gallons of concentrated lime juice. It is likely that U. S. imports of lime juice may increase gradually in the future if U. S. juice consumption expands.

While U. S. lemon juice exports are not recorded, it is probable that small quantities of U. S. lemon juice were exported to Mexico in this period.

There has also been a two-way trade in essential oils. While the United States has imported small quantities of orange oil from Mexico, it has had sustained and growing exports of orange oil to Mexico. This product is used in Mexico in the very large domestic soft drink industry. It is likely that this trade with Mexico will be continued in spite of the growing Mexican processing facilities.

The U. S. import of a small quantity of lemon oil from Mexico in 1955 is probably a statistical error, but the United States has had sustained exports of lemon oil to Mexico. This trade has also grown, and this is also for Mexico's soft drink industry.

The United States has been a large importer of essential oil of lime during this entire 10-year period. This oil has been mostly distilled oil; however, in recent years some substantial quantities of cold-pressed oil have been produced in Mexico for export. U. S. imports of lime oil have declined since 1958. In the future, Mexico will probably continue to supply the United States with about one-quarter million pounds of lime oil per year.

TABLE 19.--Citrus juices: U.S. trade with Mexico, 1950-60; October 1959 through September 1960

Year and season (calendar year)	U.S. exports to Mexico							U.S. imports from Mexico			
	Orange			Grapefruit			Blend	Lime		Unspecified	
	Single-strength	Frozen concentrate	Hotpack	Single-strength	Frozen concentrate	Hotpack	Single-strength	Single-strength	Concentrate	Single-strength	Concentrate
	1,000 gal.	*1,000 gal.*[1]	*1,000 gal.*[1]	*1,000 gal.*	*1,000 gal.*[1]	*1,000 gal.*[1]	*1,000 gal.*	*1,000 gal.*	*1,000 gal.*[2]	*1,000 gal.*	*1,000 gal.*[3]
1950	23	--	--	11	--	--	--	25	2	--	--
1951	24	--	--	21	--	--	--	4	4	6	--
1952	28	--	2	16	--	1	5	--	24	--	--
1953	19	--	3	24	(4)	2	--	29	90	--	--
1954	17	--	3	10	--	7	5	20	69	--	246
1955	2	--	1	2	--	7	1	18	106	--	64
1956	8	--	2	10	--	15	1	12	66	11	249
1957	20	--	(4)	33	--	25	2	18	--	11	2
1958	23	6	3	15	4	31	6	39	1	17	82
1959	22	8	1	13	5	46	1	38	2	29	443
1960	27	8	2	23	3	51	4	24	31	16	1,886
1959:											
October	--	--	--	--	--	7	--	--	1	--	--
November	6	(4)	--	--	--	1	--	(4)	--	--	--
December	1	--	--	--	--	4	--	1	--	--	--
1960:											
January	(4)	2	--	2	1	3	1	1	--	3	--
February	1	--	(4)	2	1	5	(4)	2	--	--	421
March	2	1	(4)	--	1	3	(4)	1	--	1	312
April	1	3	--	2	--	4	--	--	--	(4)	204
May	1	--	--	3	--	4	1	5	--	2	109
June	1	(4)	--	4	--	4	--	2	--	--	359
July	4	(4)	(4)	3	1	7	(4)	5	--	--	16
August	3	--	--	3	--	5	(4)	6	--	--	--
September	4	(4)	(4)	3	--	4	(4)	1	3	--	296

[1] Gallons of concentrate.
[2] Single-strength equivalent.
[3] Mostly frozen concentrated orange juice, in single-strength equivalent.
[4] Less than 500 gal.

TABLE 20.--Essential oils: U.S. trade with Mexico, 1950-60; and season, October 1959 through September 1960

Year and season (calendar year)	Orange		Lemon		Lime	Unspecified
	U.S. imports from Mexico	U.S. exports to Mexico	U.S. imports from Mexico	U.S. exports to Mexico	U.S. imports from Mexico	U.S. exports to Mexico
	1,000 lb.	*1,000 lb.*	*1,000 lb.*	*1,000 lb.*	*1,000 lb.*	*1,000 lb.*
1950	--	(1)	--	(1)	220	20
1951	12	(1)	--	(1)	244	29
1952	(2)	26	--	5	271	4
1953	--	27	--	4	180	6
1954	--	47	--	3	223	2
1955	--	31	4	5	122	9
1956	--	42	--	9	210	20
1957	--	45	--	9	421	11
1958	3	50	--	22	354	17
1959	5	57	--	15	163	28
1960	--	63	--	13	177	28
1959:						
October	--	6	--	(2)	9	--
November	--	3	--	1	7	--
December	--	1	--	1	16	1
1960:						
January	--	6	--	1	8	1
February	--	4	--	1	9	(2)
March	--	8	--	1	19	2
April	--	3	--	2	22	1
May	--	7	--	3	1	1
June	--	5	--	1	12	(2)
July	--	11	--	1	18	19
August	--	3	--	2	10	1
September	--	3	--	1	40	1

[1] Not separately classified; included in citrus oils, natural, prior to January 1952.
[2] Less than 500 boxes.

Mexico is a market for small quantities of unspecified essential oil which includes such items as stripper oil. In 1960, about 28,000 pounds of such items were sold in Mexico.

Outlook

Processing of oranges seems likely to expand after 1965, both to serve a growing domestic market and to supply an export market in Canada, the United States, and Western Europe. As processing expands it is likely that other U. S. juice interests may become associated with Mexican processors. It is likely also that most of the production of juice partly financed or directed by U. S. firms will not be sold in U. S. markets. The opportunities to sell Mexican juice in the United States are limited by the fact that the Mexican fruitfly is present to some degree in all citrus areas. When either orange or grapefruit juice is produced from fruitfly-infested areas, some lots of the juice are likely to contain either maggot eggs or insect particles. Juices with these defects offered for import in the United States would be rejected by the Food and Drug Administration.

It is likely that U. S. processors will experience most competition from Mexican orange juice in such markets as Canada.

The immediate outlook for lime processing seems less assured. The immediate future will probably see a decline of lime processing in Mexico. It is likely that the small private firms will continue to be out of business and the most of the processing will be done by the large semigovernment organizations. Purchasers of Mexican lime oil complain that they are now unable to buy oil from a specific source and of a specific quality. It is possible that some of such buyers may seek other sources of lime oil and the results of Mexico's attempt to stabilize the export market for essential oil and lime juice may result in increased competition from other world lime producing areas. It is, therefore, possible that Mexico may be a smaller exporter of essential oil of lime and lime juice.

It is certain that from the point of view of the world market, Mexico is now less competitive in lime products.

TABLE 21.--Orange trees: Acreage and production by States, Mexico, 1949 and 1958

State	Number of producing trees		Acreage		Production[1]	
	1949	1958	1949[2]	1958	1949	1958
	Thousands	*Thousands*	*Acres*	*Acres*	*Boxes*	*Boxes*
Coahuila..........................	4	([3])	35	7	3,968	665
Chihuahua.........................	19	17	306	277	52,186	39,095
Durango...........................	60	44	983	719	158,070	86,934
Nuevo Leon........................	1,882	3,825	31,018	63,011	5,165,063	7,745,748
San Luis Potosi...................	369	953	6,086	15,696	1,021,895	1,860,593
Tamaulipas........................	203	201	3,346	3,306	490,177	455,702
Zacatecas.........................	27	16	450	269	58,044	37,788
Campeche..........................	54	69	892	1,137	144,968	187,971
Quintana Roo......................	9	8	141	138	21,574	20,235
Tabasco...........................	72	94	1,181	1,544	190,037	234,443
Veracruz..........................	1,073	2,482	17,673	40,883	2,433,123	6,053,371
Yucatan...........................	149	190	2,446	3,131	349,398	504,694
Baja California...................	13	3	222	49	30,046	5,776
....do................Territorio..	0	12	0	190	0	25,343
Nayarit...........................	20	15	333	255	38,140	37,563
Sinaloa...........................	33	19	539	311	81,759	40,148
Sonora............................	76	90	1,253	1,478	201,406	216,479
Colima............................	8	5	138	89	22,235	12,157
Chiapas...........................	92	146	1,510	2,407	243,923	343,665
Guerrero..........................	29	47	477	766	62,642	105,633
Oaxaca............................	82	128	1,347	2,108	196,083	313,321
Aguascalientes....................	20	15	326	245	55,367	32,628
District Federal..................	1	([3])	15	7	2,205	927
Guanajuato........................	22	26	356	425	55,902	64,721
Hidalgo...........................	133	114	2,192	1,880	344,295	262,190
Jalisco...........................	333	371	5,486	6,116	784,680	907,058
Mexico............................	21	34	353	556	44,218	70,718
Michoacan.........................	106	120	1,747	1,972	208,839	267,780
Morelos...........................	34	10	563	171	76,405	20,233
Puebla............................	172	339	2,827	5,589	380,042	859,965
Queretaro.........................	19	12	309	195	31,872	28,796
Tlaxcala..........................	1	0	15	0	1,764	0
Total............................	5,134	9,405	84,565	154,927	12,950,326	20,842,340

[1] Converted from metric tons to boxes of 70 lb.
[2] Computed at 150 trees per hectare (61 trees per acre).
[3] Less than 500.

TABLE 22.--Lime trees: Acreage and production by States, Mexico, 1949 and 1958

State	Number of producing trees		Acreage		Production[1]	
	1949	1958	1949	1958	1949	1958
	Thousands	*Thousands*	*Acres*	*Acres*	*Boxes*	*Boxes*
Chihuahua	2	5	30	74	2,149	5,511
Durango	5	4	84	62	4,767	3,990
Nuevo Leon	6	7	101	124	4,933	5,934
San Luis Potosi	89	49	1,468	813	80,027	50,779
Tamaulipas	137	191	2,251	3,150	174,990	209,845
Zacatecas	3	2	44	37	2,673	1,998
Campeche	8	16	133	269	8,984	23,563
Quintana Roo	4	2	64	35	3,693	2,647
Tobasco	35	49	576	808	44,147	70,176
Veracruz	170	271	2,800	4,455	199,103	331,986
Yucatan	42	47	684	773	41,254	64,555
Baja California TN	(2)	3	7	47	606	2,270
Territorio Baja California TS	1	6	15	96	1,268	7,303
Nayarit	16	23	268	376	20,117	27,133
Sinaloa	23	28	371	460	30,920	32,869
Sonora	5	11	86	173	6,443	10,428
Colima	355	246	5,841	4,052	397,104	378,280
Chiapas	53	77	880	1,260	65,394	85,259
Guerrero	42	123	699	2,019	51,119	140,007
Oaxaca	53	88	870	1,446	66,331	97,652
Aguascalientes	3	1	47	15	3,197	965
District Federal	1	(2)	15	2	799	114
Guanajuato	11	10	178	173	13,228	11,416
Hidalgo	44	59	719	974	59,910	67,597
Jalisco	70	74	1,149	1,226	101,108	85,396
Mexico	11	19	188	314	12,180	21,587
Michoacan	302	370	4,979	6,091	346,095	491,887
Morelos	17	18	282	301	18,105	18,327
Puebla	23	100	385	1,653	26,317	137,427
Queretaro	5	6	82	94	4,519	5,833
Tlaxcala	1	(2)	20	5	965	316
Total	1,537	1,905	25,316	31,377	1,792,450	2,393,050

[1] Converted from metric tons to boxes of 80 lb.
[2] Less than 500.

TABLE 23.--Fresh fruit packinghouses having sterilization chambers in 1961 capable of treating fruit exported to the United States

Name of fruit sheds	Location	Name of fruit sheds	Location
Cadereyta	Cadereyta, N.L.	Allende	Allende, N. L.
Beneficiadora	Montemorelos, N.L.	Jesus Maria	Gral. Teran, N.L.
Nuevo Leon	Montemorelos, N.L.	Compania Naranjera	Gral. Teran, N.L.
Mexico No. 1 & No. 2	Montemorelos, N.L.	Cantu	Gral. Teran, N.L.
Montemorelos	Montemorelos, N.L.	Casas Blancas	Huatahuises, N.L.
Carlos Gerardo	Montemorelos, N.L.	De Leon	Linares, N.L.
Hualahuises	Montemorelos, N.L.	Naranjas, Mexicanas	Linares, N.L.
Valencia	Montemorelos, N.L.	Uriegas No. 2	Linares, N.L.
Uriegas No. 1	Montemorelos, N.L.	Citricultores de Tamaulipas	El Carmen, Tamps.
Ramirez	Allende, N.L.	Rio Verde	Rio Verde, S.L.P.
Buena Vista	Allende, N.L.		
Zaragoza	Allende, N.L.		

Source: The trade.

TABLE 24.--Mexican export duties, citrus and citrus products, 1961

Tariff No.	Item	Specifications	Official price		Duty	
			Pesos	U.S. dol.	Specific	Ad valorem
			Per kilo[1]	*Per pound*[1]		*Percent*
060 00 02	Citron	Fresh............................	0.25	0.009	Exempt	3
060 00 10	Lemons	....do..........................	0.50	.018	..do..	3
060 00 11	Limes	Fresh, West Indian...............	1.00	.036	..do..	10
060 00 12	..do..	Fresh, "Real" (large)............	0.60	.022	..do..	5
060 00 18	Oranges	Fresh	0.80	.029	..do..	3
060 00 27	Grapefruit	Fresh	0.65	.024	..do..	3
060 00 96	Citrus fruit	Unspecified......................	0.80	.029	..do..	13
060 00 01	Lime juice....	....	None	None	..do..	Exempt
060 00 03	Orange juice .	....	..do..	..do..	..do..	..do..
541 00 00	Lime oil	Packed in tin and wood and exported within the annual official quota.	..do..	..do..	..do..	..do..
541 00 01	..do..	Packed in tin and wood but exported outside the official annual quota.	83.05	3.014	..do..	3
541 00 02	..do..	In unspecified packing and exported within the official annual quota.	..do..	..do..	..do..	1
541 00 03	..do..	In unspecified packing and exported outside of the official annual quota.	..do..	..do..	..do..	5
541 00 04	Orange oil	All classifications	None	None	..do..	Exempt

[1] Gross weight.

Source: Mr. Roberto Solis, Economist, Office of the U.S. Agricultural Attache, Mexico City.

TABLE 25.--Mexican import duties, citrus and citrus products, 1961

Tariff No.	Item	Specifications	Official price		Duty		
			Pesos	U.S. dol.	Specific	Ad valorem	Ad valorem
			Per kilo[1]	*Per pound*[1]	*Pesos per kilo*[1]	*U.S. dol. per lb.*[1]	*Percent*
060 00 06	Lemons	Fresh.........................	4.50	0.163	0.25	0.009	40
060 00 09	Oranges	....do........................	1.30	.047	.60	.022	75
060 00 13	Grapefruit	....do........................	1.70	.062	.50	.018	75
062 00 03	Orange juice	With a specific gravity up to and including 1.25 at 15°C. (Less than 53.3 degrees Brix)	[2] 16.00	[2] .581	[2] 2.70	[2] .098	40
062 00 06	Grapefruit juice	....do........................	[2] 5.90	[2] .214	[2] 2.70	[2] .098	40
062 00 08	Fruit juice	With a specific gravity over 1.25 at 15°C. (Over 53.3 degrees Brix)	[2] 38.00	[2] 1.379	[2] 4.00	[2] .145	70

[1] Gross weight.
[2] "Legal" kilos and pounds; includes weight of first container but excludes weight of packing cases.

Source: Mr. Roberto Solis, Economist, Office of the U.S. Agricultural Attache, Mexico City.

Excerpts from Studies on the Biology and Control of the Blackfly (Aleurocanthus Woglumi)[1]

The first discoverers of the devastating pest commonly called "citrus blackfly" were Maxwell Lefrey, George Campere, and Woglum. Woglum discovered the fly in the Gardens of Ceylon; Lefrey found it in India, and Campere in Manila. These discoveries were made in 1910.

In the Republic of Mexico, the citrus blackfly was discovered in 1935 by Arthur C. Baker and Alfonso Dampf. The infestation was found in the citrus orchards in "El Dorado" (Sinaloa). Infestation extended alarmingly through the principal citrus zones.

. . . As the pest had spread alarmingly and the parasite Eretmocerus serius did not give satisfactory results in Cuba and Panama, in August 1947 the United States Government made a study to determine the extent and intensity of the plague in Mexico, and as a result, established a protection front of 550 kilometers from the frontier where spraying was carried on in order to eradicate the pest; this was also done along the Pacific Coast to protect California citrus. The Governor of Veracruz began to combat the pest by chemical control, and succeeded in eradicating the fly in the Municipios of Xico and Coatepec. This work was done under the direction of Sr. Agr. Celestino Escalante E. The Mexican Government, observing the loss by citrus growers, considered it of public interest to combat the blackfly. On October 6, 1948, the organization, "Comite Nacional de Combate y Control de la Mosca Prieta de los Citricos" was formed.

. . . The fight against the citrus blackfly has two phases: (1) prevent the advancement of the blackfly into "clean" zones, and (2) exterminate the blackfly, its larvae, and eggs completely.

The fight is carried on by tiny parasites, described in the section relative to biological control. In many places its attack has been rewarding, in others artificial control is still used with Citrolina, and Malathion.

Infestation

. . . The blackfly prefers to begin its infestation on young leaves, rarely on mature leaves, and hardly ever on old leaves. Since there are few leaves infested at first, it is difficult to distinguish the different forms, but as soon as the insect has taken hold almost all of the leaves are filled with all forms from empty shells of the pupae and adults to new spirals and first-stage larvae.

Combating the Plague

Aspersions

. . . The eradication program in zones where new infestations are found is three aspersions with a 3-week interlude between each. Citrolina-Cube is used and another spraying 3 weeks later of DDT-petroleum. Considering the growth of the leaves, the duration of the emergence of the adults and appearance of scales, the trees are sprayed every 3 weeks.

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[1] Translated and prepared by Joe M. Ramirez, plant pest control Inspector, USDA, from Spanish Literature and material from the Secretaria de Agricultura y Ganaderia, Mexico, D.F.

In infested areas a systematic program of 3 sprayings per year was used. Economically, 2 should be enough, and the ideal would be to spray each biological cycle. Each yearly season determines the sprayings. The second half of fall, winter, and the early spring are generally the best times. In the summer the heat and drought (more than 30 degrees C.) and relatively low humidity of 50 percent burn the insects on the foliage. In September, the rains impede the work and the trees are sprayed during rain lulls.

Malathion Spraying

The sprayings are not encouraged during blossom time. Studies in the United States indicate that the fruit should be one inch in diameter and spraying cherry and lemon-size trees depends on their size.

Mortality Count

. . . If a grove is sprayed when most of the mature leaves have live pupae, the insecticide's effect is seen within 13 days. All the pupae on a leaf are counted, then with a needle, each pupa is pricked to observe the effects. If the pupa is dead, the shell is empty, if not, there is a waxy secretion. Six hundred pupae were counted; 100 were still alive, therefore, the mortality rate was 83 percent.

On small lots, the mortality is almost 100 percent. The large groves present problems; lack of water causes loss of time and delay, the terrain sometimes retards the work, the unpruned trees or the undergrowth, etc. Then, there are climatic impediments; there is rain and the ground is muddy, so there can be no spraying, etc.

Biological Control

. . . Infestations of hard-to-reach trees led to the use of the tiny "yellow bee" (Eretmocerus serius Silvestri). These bee liberations are used on the sections where the trees cannot be reached by other means. The area covered is now enormous and in humid weather there are greater concentrations.

The yellow bee lays its eggs in the first and second stages of the blackfly larvae. The bee is hatched and perforates the ventral region on the thorax. The bee larvae enter, worm-like, and devour the blackfly larvae. Before the fly can pupate the bee emerges, making a circular opening on the pupa's dorsal. The yellow bee has a great and active searching power. Its ovipositor is internal, and since it prefers to deposit its eggs in the first and second stages of the blackfly larvae, it kills the fly, but does not reproduce itself. The parasite's biological cycle lasts about three weeks.

The yellow bee's existence depends greatly upon climatic conditions, therefore, other bees were used. The "black bee" was used which has a greater resistance to the climate. Early 1950 saw the liberation of approximately 7,000 specimens. Several months later, a minute search revealed 5 live bees. Finally, great numbers of the Prospaltella species were produced in Cuernavaca, Morelos. Six thousand were taken into the Matlapa and Tamazunchale area and within 6 months bees were produced in amounts great enough to send bees to all infested areas of the Republic. Within 9 months, more than 1,000,000 bees had been distributed from this area. The parasitic advance had increased from a 1 percent effectiveness in 3 months to 49 percent in 9 months. Pupae per leaf fell from 228 to 70, or 69 percent decrease.

Dr. Herbert D. Smith, from the United States, personally collected the first blackfly-parasites in Asia and introduced them into Mexico.

The populous black bee in the Tamazunchale area is *Prospaltella smithi Silvestri*. This bee of the Hymenoptera order lives principally on the third stage and young pupae of the blackfly so that egg loss is reduced. The ovipositor is stronger and since the bee eggs are laid in a later stage of the fly's cycle, the bee survives in greater percentages. The adult bees live off the fly's honey-like excretion more than 12 days. Its biological cycle is about 5 weeks.

Organismo Internacional Regional de Sanidad Agropecuaria (Oirsa)

Brief History of the Mediterranean Fruitfly in Central America

The Mediterranean Fruitfly, *Ceratitis capitata* (Weid.) was found for the first time in Costa Rica during April of 1955. The fruit infested with this species originated from Santa Ana, Costa Rica, a small town on the Meseta Central.

Shortly after the discovery of this pest in Costa Rica, Dr. L. D. Christenson, Entomologist in charge of Fruitfly Investigation in Hawaii, Mr. W. E. Stone, Entomologist in Charge of Fruitfly Investigations in Mexico, Dr. Harold Mowry, STICA, and Mr. Luis A. Salas, Entomologist, University of Costa Rica, cooperated in making a survey of the Meseta Central and Turrialba Valley. Results of this survey indicated that the Med fly was present throughout the Meseta Central, in isolated areas in Turrialba, at Orosí in Cartago Province and in San Ignacio de Acosta in San José Province. At this time on the Meseta Central the preferred host appeared to be sweet orange. In the Turrialba Valley, the preferred host was coffee.

During 1955 and 1956 trapping was carried out to determine the extent of the infestation, as well as to determine the most effective baits for attracting the Med fly. In addition, control operations, primarily on an experimental basis were carried out in selected citrus groves. It might be said that during this two year period no serious attempts were made at controlling the Med fly on a national basis. Apparently, no serious efforts were made to initiate an eradication campaign. The primary purpose seemed to be to carry out an intensive investigation of the Med fly in Costa Rica.

During the course of the IV CIRSA Reunion, celebrated in Panama City during February 1957, it was resolved by the Ministers of Agriculture of the seven OIRSA member countries (Mexico, Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica, and Panama) to initiate a program of work against the Med fly in Costa Rica. This program was designed to eliminate isolated, outlying infested areas encircling the Meseta Central and the Turrialba Valley, which represented the two most heavily infested areas in Costa Rica. In addition, the program was designed to: (1) demonstrate that elimination of such isolated outbreak areas could be achieved; (2) prevent the Med fly from spreading; and (3) stimulate interest from international sources in cooperating with a larger scale program. Included with this program were increased trapping operations throughout all of Costa Rica in order to have reliable data concerning the distribution of this pest, and the initiation of domestic quarantine services to eliminate the uncontrolled spread of infested host material. To finance this program, OIRSA allocated US$36,225.43 from its normal quota sources and an additional US$70,000.00 was secured from an extraordinary quota approved by the Ministers of Agriculture. This represented a US$106,225.43 Med fly program which was paid in full and was in operation during the fiscal year 1957-58.

In early 1958, there were indications that the United States might be interested in investigating the possibilities of a cooperative program against the Med fly in Costa Rica. Consequently, the First Extraordinary CIRSA Reunion was held at San José in an effort to determine if a cooperative program could be achieved. At this time, the Ministers of Agriculture of the OIRSA member countries, agreed upon levying an extraordinary quota of US$16,000.00 upon each member country in order that a cooperative program with the United States might be financed. At this meeting were Dr. Stanley Fracker and Mr. Gregor Rohwer as U. S. Technical Advisors, and Mr. Rollin Atwood, Director Latin American Region, ICA. The tentative, cooperative program, had it gone into operation, would have consisted of: (1) an intensification and continuance of the trapping program for more definite statistical information concerning the distribution of the Med fly in Costa Rica; (2) a continuance of eliminating isolated, outlying outbreaks; and (3) a continuance of the domestic plant quarantine services. The outcome of this first cooperative program and the availability of economic resources would then determine future programs. Unfortunately, this cooperative program never materialized. Since OIRSA was economically unable to finance this program in its entirety, it was necessary to initiate another type program in order to protect the other OIRSA member countries from being invaded by the Med fly. Consequently, OIRSA on January 1st, 1959, initiated a frontier program at the Nicaraguan-Costa Rican frontier and at the Panamanian-Costa Rican frontier, which was in accord with available OIRSA funds and which would prevent the Med fly from spreading to the six remaining OIRSA member countries.

This frontier-type program, which consisted of trapping throughout a predetermined zone on either side of the Nicaraguan-Costa Rican and Costa Rican-Panamanian frontiers, and immediate elimination of any outbreaks of the Med fly that might be encountered, continued successfully for more than two years. During the latter part of January 1960, Med flies were encountered for the first time in traps placed in the vicinity of San Marcos, Jinotepe, and Diriamba, Nicaragua, approximately 35 kilometers South of Managua and about 100 kilometers from the Nicaraguan-Costa Rican frontier. The initial outbreak area as determined in 1960 was approximately 10 kilometers by 12 kilometers and elimination of this outbreak area was beyond the economic possibilities of either Nicaragua alone, or in cooperation with OIRSA. Consequently, along the Nicaraguan-Costa Rican frontier the preventive program was discontinued. Along the Panamanian-Costa Rican frontier, the program was continued since surveys throughout Panama, specially along the frontier region still continued to reveal an absence of the Med fly.

At the VII CIRSA Reunion celebrated at Mexico City, during February 1959, the Ministers approved a resolution permitting OIRSA to initiate a program of investigation of biological control against the Med fly, with its laboratory in San José, Costa Rica. This program of investigation was initiated on 1 July 1959, and at the present time, OIRSA is still carrying out these investigations in both Costa Rica and Nicaragua.

In addition, OIRSA is collaborating with the Nuclear Energy Department of the Inter-American Institute of Agricultural Sciences at Turrialba, Costa Rica, concerning its investigation with sterilization of male Med flies for release in a selected, isolated infested area.

At this time it can be said that OIRSA is: (1) providing funds for the operation of a frontier program along the Costa Rican-Panamanian frontier to keep the Med fly from entering Panama; (2) carrying out investigations concerning the biological control of Med flies and fruitflies of the genus Anastrepha with laboratories located in San José, Costa Rica and Managua, Nicaragua; (3) providing technical assistance in carrying out trapping programs in all OIRSA member countries including those where the Med fly does not occur; (4) providing technical assistance in intensifying and enlarging plant quarantine services throughout the OIRSA Region; and (5) providing technical assistance in national programs of chemical control against the Med fly in Costa Rica and Nicaragua.

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